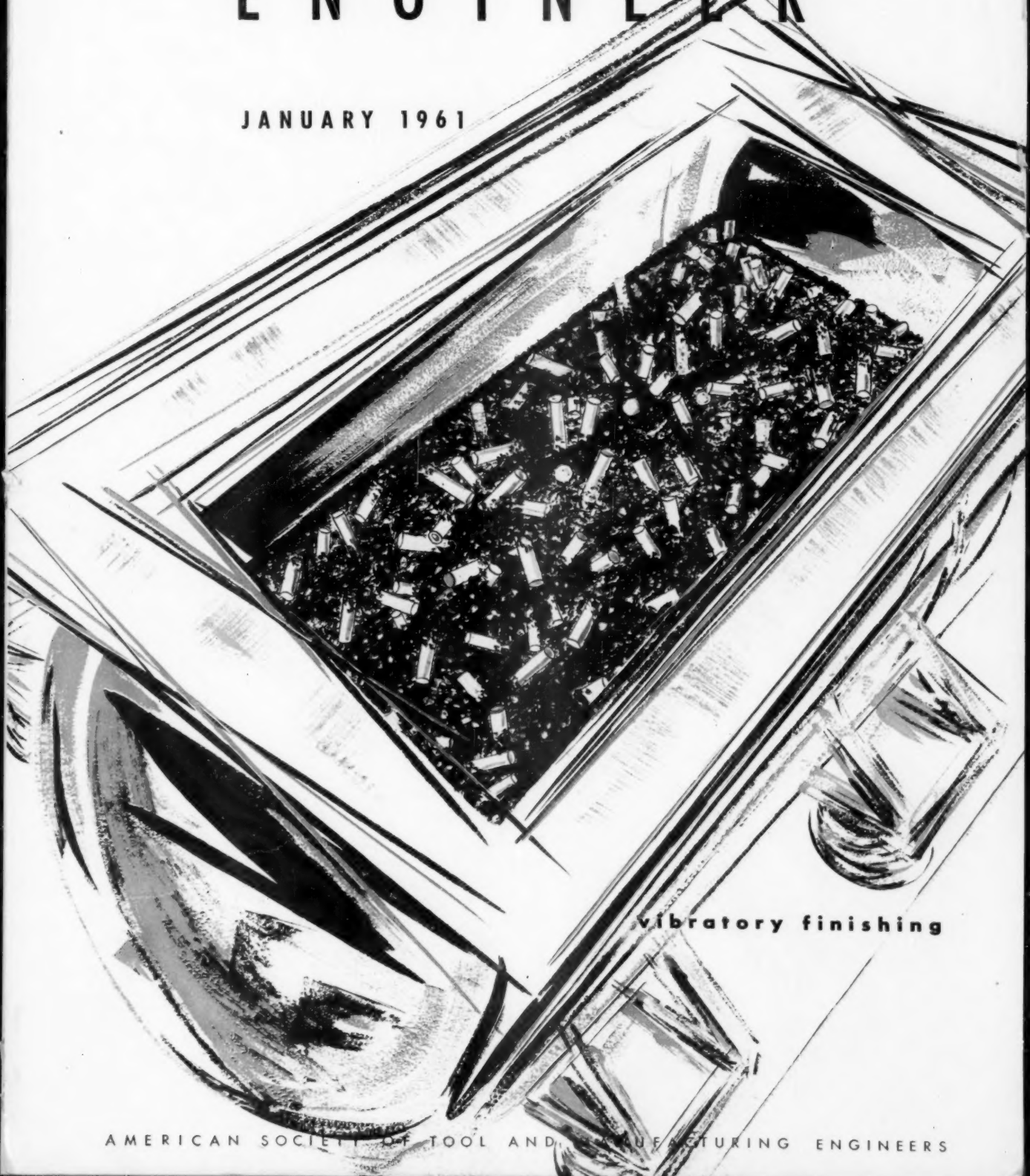
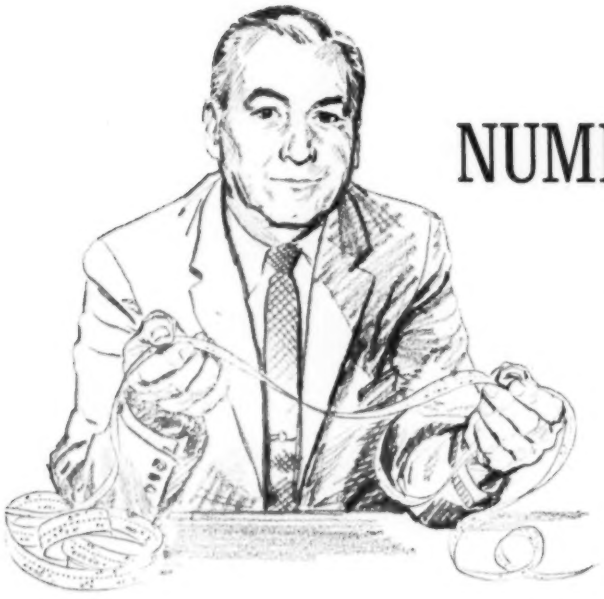
the TOOL and MANUFACTURING ENGINEER

JANUARY 1961



vibratory finishing

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS



NUMERICAL CONTROL...

A Realistic Appraisal

by A. Francis Townsend
Vice President, Engineering
The Heald Machine Company

At the 1960 Machine Tool Exposition, numerical control emerged as the shining new star on the metalworking horizon. In fact, if you didn't have something numerically controlled to demonstrate, you just weren't in the running.

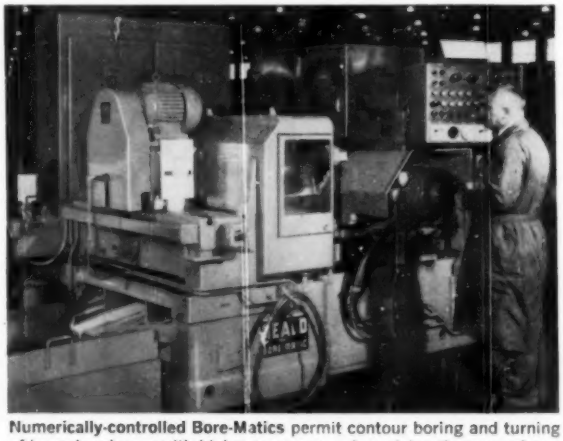
This subject is one that deserves a realistic appraisal. Is it a "fad" that will not stand the test of time? Or is it a panacea, a cure-all, that will eventually make all manually-operated machines obsolete?

Since Heald offers both numerically controlled and manually operated machines, we can afford to look at the subject objectively. Of this we can be sure—numerical control is here to *stay*. On the other hand, we can be equally sure that it is not the universal solution to all machining problems —and that manual operation will also be around for a long time to come.

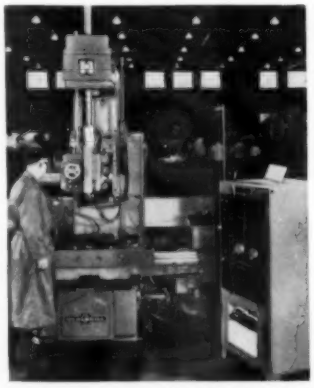
Where to use numerical control is largely a matter of production economics. How far it can be *profitably applied* depends on many factors, including the nature of the workpiece and the operations to be performed. In general, however, numerical control will usually be most advantageous where any of the following conditions are encountered.

1. Where several different setups are required on the same or different workpieces.
2. Where the operations performed are complex in nature.
3. Where manual setup time is relatively high.
4. Where time for tooling design, manufacture and use must be reduced.
5. Where variety and complexity of work require excessive tooling cost.

Properly applied, numerical control offers many profitable opportunities for making substantial cost reductions. Improperly applied, it will be a disappointing investment.



Numerically-controlled Bore-Matics permit contour boring and turning of irregular shapes with higher accuracy and precision than were heretofore obtainable. In routine production, the machine shown here contour turns an aluminum workpiece to ± .0001" of true path.



Numerically-controlled HEALDRILL makes high-precision layout or production drilling **fully automatic** —with tape control of precise hole location as well as selection of speeds, feed rates and tool change indication. A taped program for any workpiece can be stored and reused whenever needed for exact duplication of the most complex drilling operations.

Your Heald engineer is fully qualified to help you evaluate the economics of numerical control for Borizing, grinding and precision drilling operations. It will pay you to call him in before taking the "plunge."

THE HEALD MACHINE COMPANY
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the TOOL and MANUFACTURING ENGINEER

Volume 46
No. 1

January
1961

Direct Energy Conversion—Key to Lower-Cost Manufacturing? 71
New conversion devices may make it possible—some day—to power machine tools directly with energy from the sun.

Gadgets 73
Relieved punch sets die radius . . . chuck jaws activated by centrifugal force . . . cross-hole drilling method for turret lathes.

Controlled Vibration—Key to Parts-Finishing Efficiency ..... *By T. W. Black* 77
Vibratory finishing machines are capable of much faster parts finishing cycles than conventional rotary barrels and give precision results.

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Selecting the right type of wheel—and maintaining that wheel properly—are important to over-all efficiency in electrolytic machining.

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Plastics Tooling for the Job Shop ..... *By R. M. Radl* 91
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Cast-to-Size Steel Molds Cut Compact Car Costs 94
Cast permanent molds are being successfully applied for the low-pressure casting of aluminum engine components.

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Ceramic tools with large negative rakes have excellent life, even when cutting materials as hard as Rc 61.

Drawing in Three-Dimensional Space 102
A revolutionary machine that makes three-dimensional drawings could be used to check cutter paths prior to actual metal removal.

Getting the Most out of Shell Molding ..... *By Otto W. Winter* 109
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THIS MONTH'S COVER

During the past year, vibratory finishing has fully proved its ability to speed parts finishing. Cover artist William Solms shows a vibratory finishing machine in action. The load in the tub is a mixture of parts and abrasive stones. When the tub is vibrated, the abrasive removes burrs and sharp edges and improves the surface finishes of the parts. An article on vibratory finishing starts on page 77.

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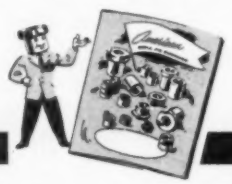

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Now is the time . . .
To plan your future, because no one ever gets ahead by looking backwards.

Now is the time . . .
To establish your goals in life, because no one ever gets anywhere unless he knows where he's going.

Now is the time . . .
To study your roads to these goals, because no one ever gets lost when he has a good map.

Now is the time . . .
To prepare yourself for your journey, because no one ever gets far unless he's got what it takes.

Now is the time . . .
To acknowledge that you have much to learn, because no one ever succeeded in knowing it all.

Now is the time . . .
To study, because no one ever becomes wise unless he tries.

Now is the time . . .
To work, because no one ever achieves success without sweat.

Now is the time . . .
To start, because no one ever gets anyplace until he gets started.

Now is the time . . .
To remember that no one ever really gets something for nothing . . . that those who give the most get the most . . . that the rewards are greatest for those whose service is greatest . . . that the most important advances in manufacturing engineering are conceived and developed by engineers who master their field, then make creative contributions to that field . . . and that *your* success, like theirs, depends on *your* knowledge and hard work.

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John W Greve

EDITOR

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preview

. . . a fast look at this issue

Electricity from the Sun? **71**

For centuries, scientists and engineers have been seeking ways to tap solar energy directly so that it can perform useful work. Until recently, the most promising approach seemed to be to use solar heat, focused by a lens or parabolic mirror, to generate steam that could be used to run an engine that in turn could run an electrical generator.

Within the past several years, scientists have had some success with so-called "solar batteries" that convert the sun's energy directly into electricity. The latest developments in this research are highly promising, so promising that they are covered in the lead article in this issue.

While electrical machine tools may never be directly powered by solar energy, energy converters now under development could trap and store excess heat developed in plant operations such as machining, releasing it when needed in the form of heat or electricity.

Vibratory Finishing **77**

The greatest advance in parts finishing in recent years has been the advent of the vibratory finishing process. The process is simplicity itself: just partially fill the tub on a vibratory finishing machine with abrasive grains or stones, add the parts to be finished and water, push the button that starts the machine cycle and walk away. In an hour or two, the vibratory action will deburr the parts, generate radii on sharp corners, improve the surface finish—and do all this hundreds of times faster than manual finishing and perhaps ten times faster than other mechanical finishing methods.

Electrolytic Machining **80**

Electrolytic machining has proved its ability to machine hard materials such as carbide cutting tools efficiently and fast. The process can be made even more efficient by correct preparation of the diamond wheels used in the process and by maintaining them carefully during service. The diamond wheels do not cut, by the way. The diamonds act as spacers, separating the work surface and the metal wheel during this "deplating" process.

Plastics Tooling **91**

While the use of plastics tooling for aircraft and missile construction is well known, it is not realized that plastics offer great opportunities for cost and time savings in any plant. Most toolmakers can easily learn to mix and apply plastics and often the workpiece itself can be used as a pattern for holding fixtures, checking fixtures and the like.

Cast-To-Size Molds **94**

A cast tool steel that holds up as well as wrought materials in severe applications has been put to work in permanent molds used for a new low-pressure casting process. The molds require little machining or hand finishing after casting.

Ceramics Cut Hard Materials **99**

Some of the breakdowns of ceramic tools in service are attributable to tool design, rather than to the ceramic material itself. Experiments at Watertown Arsenal have shown that even hardened steels can be successfully cut with ceramics when large negative rake angles are used.

Drawing in Three Dimensions **102**

Conventionally, engineers have had to represent three-dimensional objects on two dimensional paper. A new machine produces an ink trace in a block of gel, enabling engineers to draw in three dimensions. Possible application: checking out a machining program developed by a computer for a numerically controlled machine. The part can be drawn in three dimensions under tape or punched card control—a less costly procedure than actually machining a metal part for checking.

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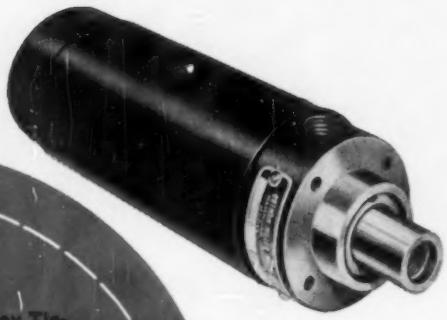

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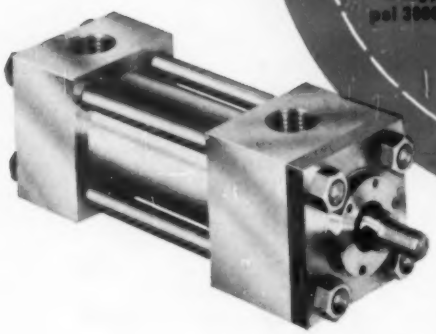
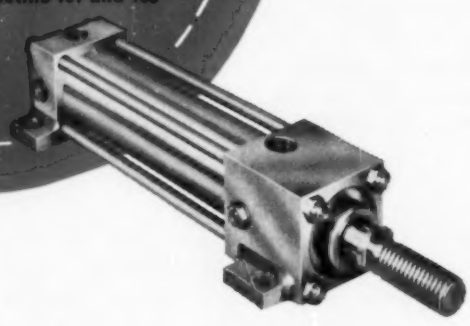


Automation Type 200 psi Air Series RA 1000 psi Hydraulic Series RH Bulletins 107 and 108



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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Some New Year's predictions, based on exhaustive surveys of what's going on in American metalworking today:

By mid-1961, the current industrial doldrums should be over. Doubts and uncertainties caused by the outcome of the recent National elections should be dispelled and management should be able to make firm plans for the immediate future.

Many of these plans have to do with plant modernization. Over the next decade, population growth and greater prosperity will mean high demand for the products of the metalworking industry. Expanded production schedules will be met, for the most part, by installing new, highly productive machines, tools, tooling and gaging.

Expansions of the type prevalent in the early 50's, when plants were literally expanded by knocking out a wall and putting an extension on the building, will be the exception, rather than the rule. With today's machine tools, often four or five times as productive as their predecessors of 10 years ago, bricks-and-mortar expansions are not necessary to achieve greater output.

As plant modernization progresses, manufacturing engineers and executives will increasingly look at the operations in their plants as parts of an over-all production system, rather than as discrete entities. This concept has, of course, been a familiar one for years in the mass production industries. But it is an equally fruitful concept for low-volume production. No manufacturer can afford the delays caused by inefficient material handling, in-process storage and bottleneck operations.

During 1960, numerical control came to maturity. Up until now, it has been put to work most frequently in large plants. During 1961, more small plants will install numerically controlled machining systems, particularly for precision drilling operations. Small plants—tool and die plants for example—simply cannot afford to put off installing numerically controlled equipment that can radically improve efficiency.

Of equal importance is the trend toward building-block machine construction. Adoption of industry-wide standards for some types of building-block units during 1960 was a step in the right direction. Availability of building-block units is, of course, not enough. Companies must install them to obtain the inherent benefits of lower-cost automation. There are indications that many companies will do just that during 1961.

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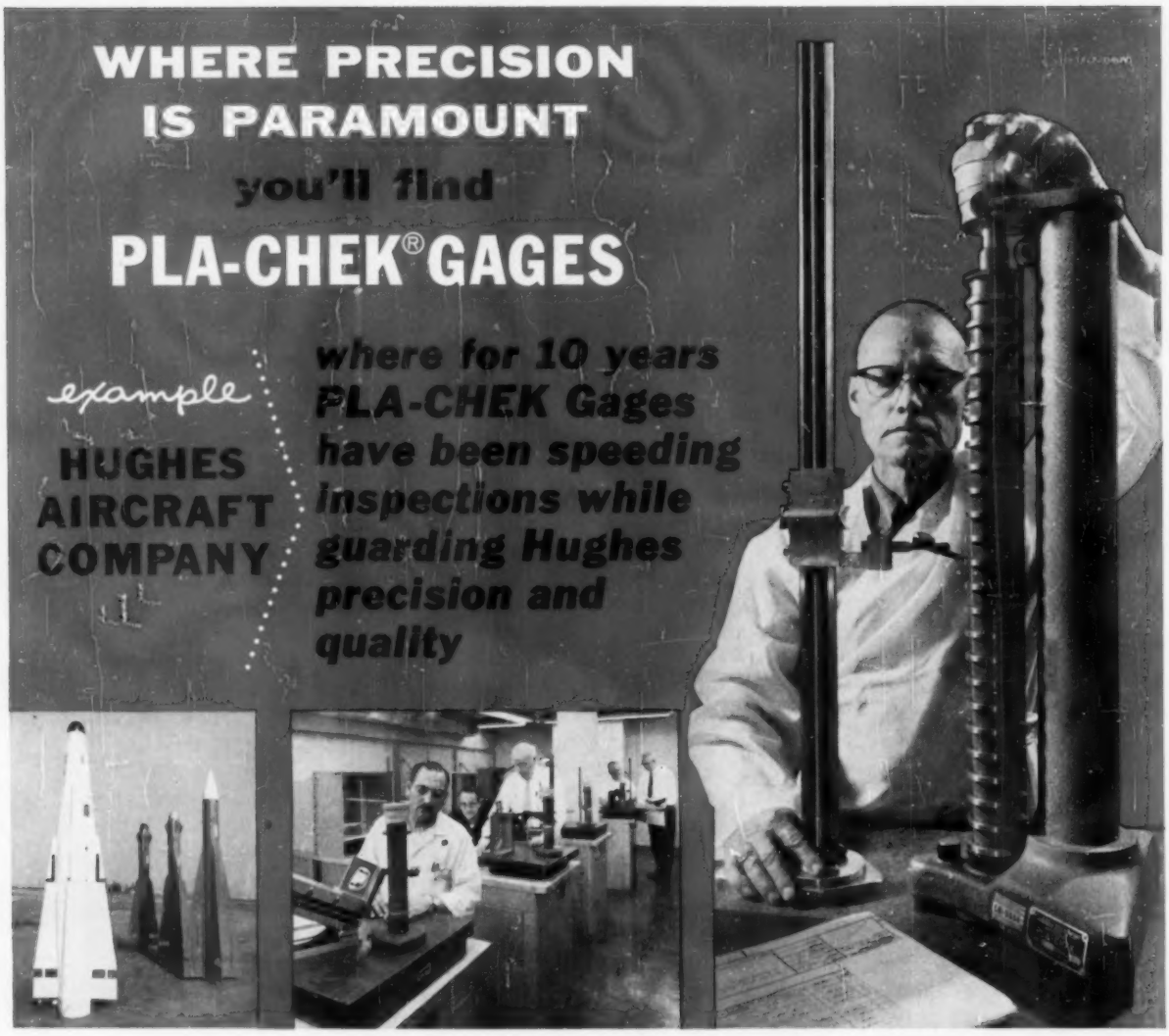

Just as the Sentinels of Freedom (at left) stand guard over America's security, so do the PLA-CHEK Gages (center) in one Hughes Inspection room guard the precision and quality of these Falcon Missiles, manufactured by Hughes Aircraft Co.

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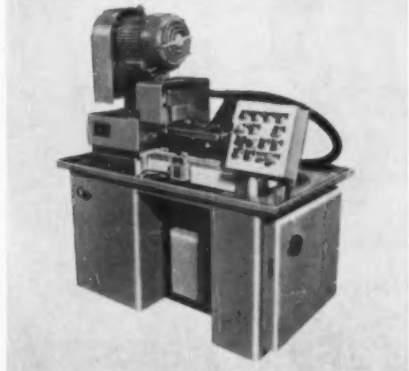

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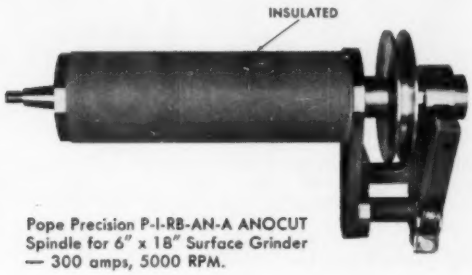

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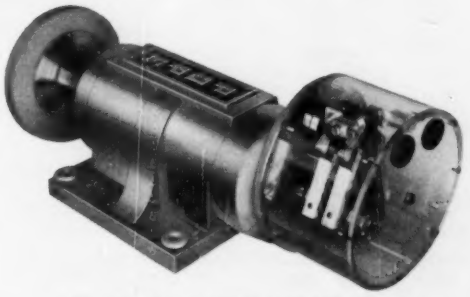

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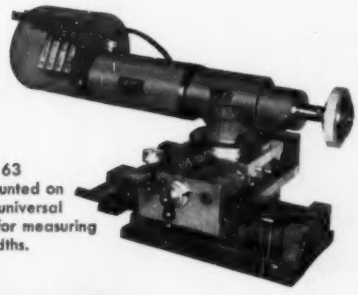
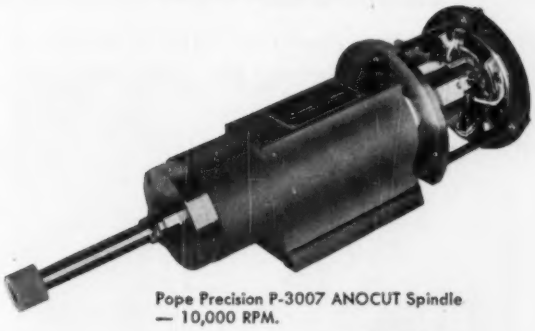
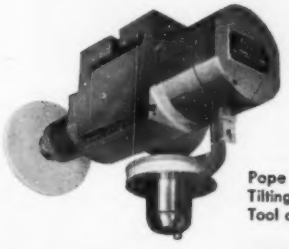


Pope Precision P-19163 ANOCUT Spindle mounted on Pope heavy duty universal slide with indicators for measuring feed in ten-thousandths.



Pope Precision P-3007 ANOCUT Spindle — 10,000 RPM.



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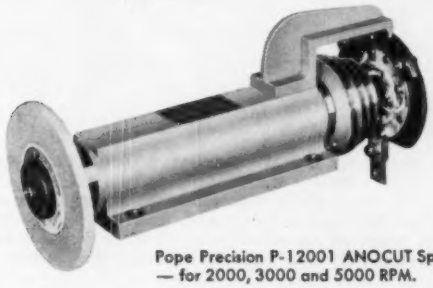

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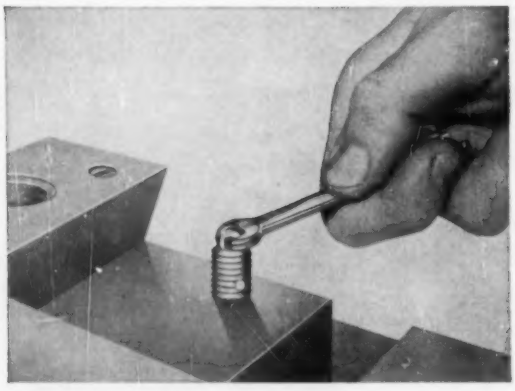
POPE MACHINERY CORPORATION • 261 RIVER STREET • HAVERHILL, MASS.

Established 1920

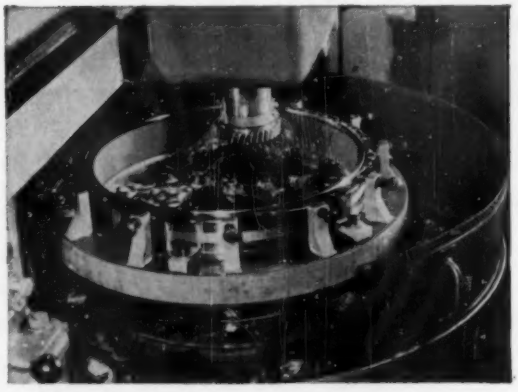
Practical Tooling Tips

No. 4 of a series

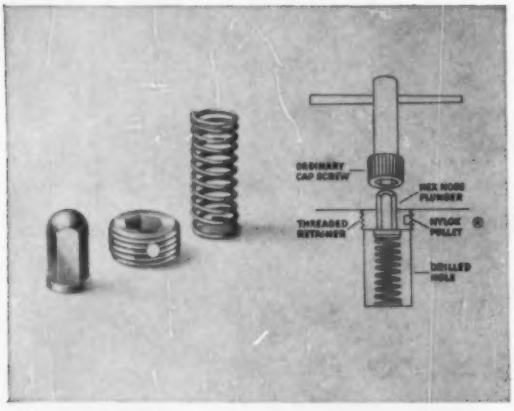
New uses are being found every day for Vlier Tooling Accessories. Perhaps the applications shown below will suggest ways you can profit by replacing costly, custom devices in jigs, dies and fixtures with precision, off-the-shelf Vlier products.



HEX NOSE SPEEDS INSTALLATION OF SPRING PLUNGERS—Vlier Hexnose Spring Plungers are easily installed with a simple end wrench. Eliminates hunting for special wrenches. Made to same exacting tolerances as Vlier Standard Spring Plungers. Available in many end pressures, diameters and lengths.



THIN-WALLED RING GEAR HELD SECURELY in fixture without distortion with 12 Vlier Torque Thumb Screws. Once pre-set end pressure is reached, knurled head spins freely, preventing overtightening. Checknut prevents backing off under vibration. Available in four types; various screw diameters and lengths.



NEW PLUNGER ASSEMBLY PREVENTS DAMAGE TO DIE STOPS—Plunger actuates automatic stop perfectly. Quickly installed, never needs adjustment. Hex nose mates with standard hex head bolts for easy insertion. Nylok® nylon pellet prevents threaded retainer from working loose. 6 sizes from ¼" to 1" diameter. Various end pressures.

FREE IDEA BOOKLET—Illustrations in this 16-page booklet show how others have profited from the use of Vlier Tooling Accessories. Shows both the usual and unusual applications. May suggest ways *you* can save. Write for your copy today.

VLIER
Engineering Corporation
A subsidiary of Barry Controls, Inc.
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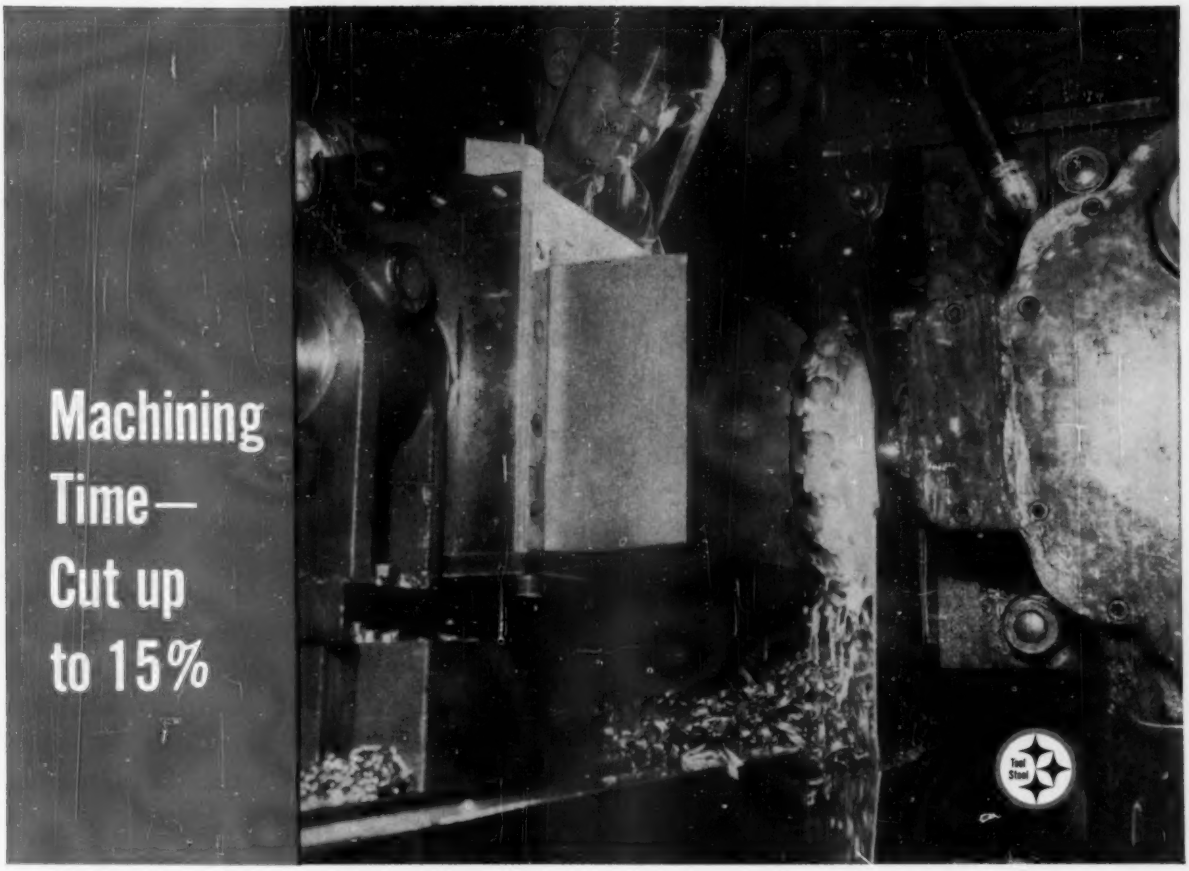


Dependable DESEGATIZED® FM Die Steels

. . . easier to work . . . easier to machine

In the production of thousands of metalworking dies, the properly dispersed alloy sulphides in Latrobe's FM High Alloy Die Steels have permitted increased feeds and speeds—*machining time cut up to 15% in most cases!* This cost-saving production is possible with no sacrifice of the excellent toughness, wear resistance and hardenability properties of the steel.

FM die steels are produced by Latrobe's Desegatized process of manufacture. This process guarantees full structural uniformity of the steel—an even distribution of the all-important carbide particles and "free-machining" alloy sulphides—your assurance of dependable quality.

Four grades of 12% chromium FM steels are regularly stocked: Olympic FM (type D-2) for long-run applications; BR-4 FM (type D-7) for extreme abrasion resistance; GSN FM (type D-3) for severe non-deforming requirements; Cobalt Chrome FM (type D-5) for extra resistance to galling and pickup.

For better die steels and technical service, call your nearest Latrobe representative. Literature on grades available upon request.

Skillfully made in U.S.A. by . . .

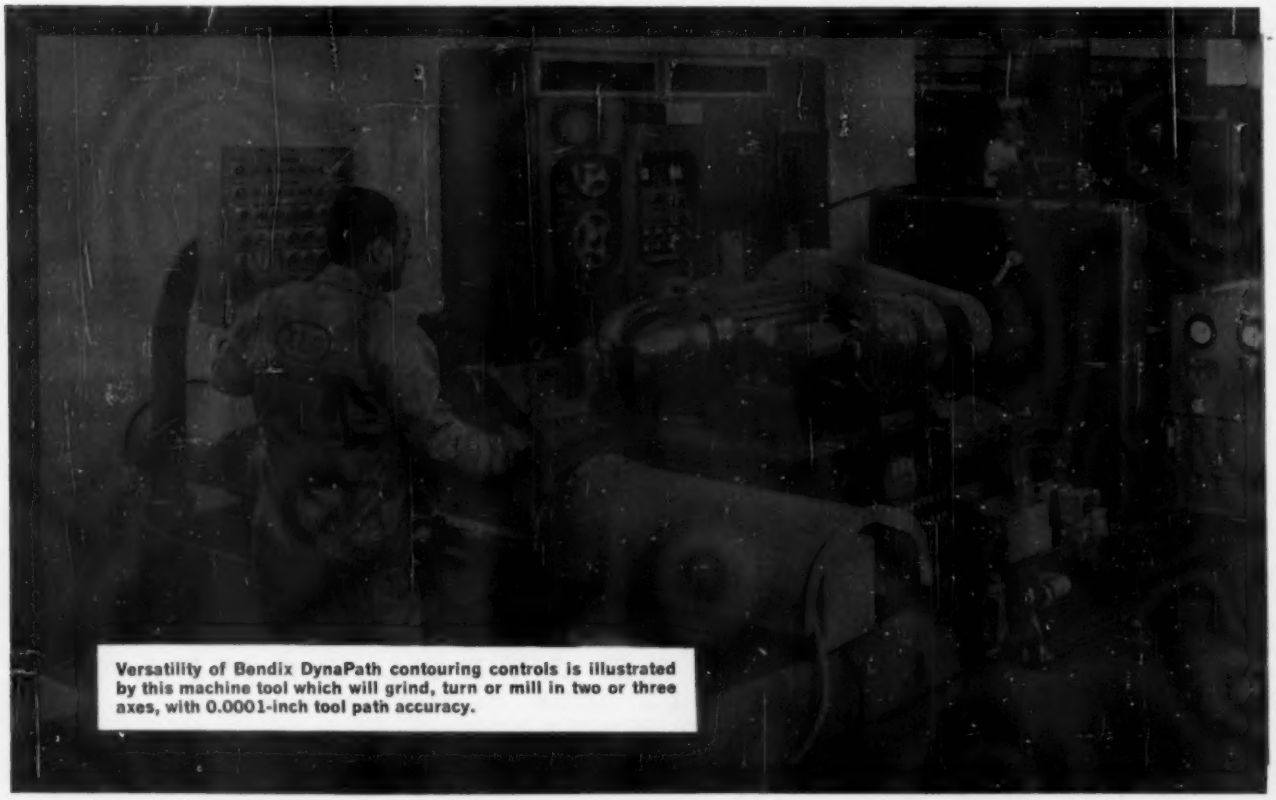
LATROBE
Metalmasters

LATROBE STEEL COMPANY
LATROBE, PENNSYLVANIA

BRANCH OFFICES and STEEL SERVICE CENTERS: BOSTON • BUFFALO • CHICAGO CLEVELAND • DAYTON • DETROIT • HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE NEW YORK • PHILADELPHIA PITTSBURGH • SAN LEANDRO • TOLEDO

BENDIX PROVIDES SYSTEMS EXPERIENCE TO MAKE NUMERICAL CONTROL WORK FOR YOU

Numerical control is a proved concept in metalworking. It has demonstrated its worth in scores of applications, but perhaps your manufacturing problems are different. Why not enlist the services of Bendix—long-time supplier of practical, reliable numerical control systems to most major machine tool builders. Let us be your prime source of information and assistance when the demand for increased productivity indicates a need for more modern equipment that will reduce scrap, reduce lead time, reduce inventory costs, and reduce tooling costs. Whether it's contouring, positioning or measuring, Bendix has the solution to your particular problem.



Versatility of Bendix DynaPath contouring controls is illustrated by this machine tool which will grind, turn or mill in two or three axes, with 0.0001-inch tool path accuracy.

YOU NEED BENDIX SYSTEMS EXPERIENCE when you consider numerical control for your application! Bendix offers:

1 JUSTIFICATION STUDIES—what can numerical control do for you?

2 SYSTEM ENGINEERING—applying the right control to the right machine tool.

3 TRAINING AND SERVICE—for maximum machine utilization rates.

The unique Bendix Systems Experience is backed up by a staff of experienced electronic, mechanical and hydraulic engineers, mathematicians, instructors, technicians, and parts planners. Our contract machining and tape-making facilities offer years of accumulated case histories on all manner of applications *and* a chance to check out *your* problems in actual practice. Why not write today for more information on Bendix Systems Experience.

Industrial Controls Section
28120 Wyoming Ave., Detroit 32, Michigan

THE Bendix CORPORATION

Bendix
SYSTEMS EXPERIENCE
For tool room work, Bendix DynaPoint positioning systems can hold 0.0001-inch tolerances on this jig borer.
With Ferranti numerical control, the turret drill will do the work of several conventional machines, and reduce scrap.

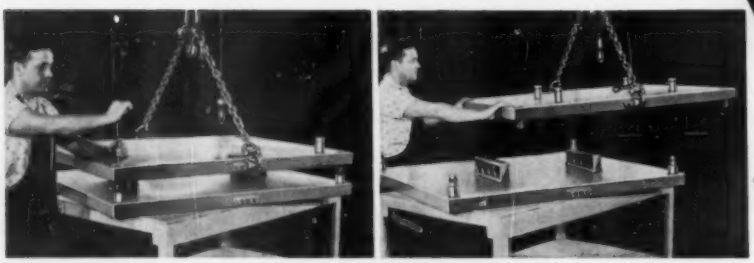
THIS IS ALL YOU NEED TO PART A SUPERIOR DIE SET EQUIPPED WITH *Removable Cap* GUIDE PINS

A Flick OF AN ALLEN WRENCH

loosens the socket head screws—the removable caps are pushed up through the bushings . . . then the punch holder virtually floats on the guide pins. That makes it a simple matter to lift the punch holder off the die shoe. Tilting or uneven lifting is not a factor when removable cap pins are used. THERE'S ABSOLUTELY NO TROUBLESOME BINDING IN PARTING DIES.

No Die Set Smash-Ups
Should foreign matter cause pin and bushing seizure, the socket screw pulls out of retaining washer . . . then the matching taper of pin and cap act as guide to prevent costly die damage.

WRITE FOR 24 PAGE CATALOG



One man parts large die set in a few minutes with Superior Removable Cap Guide Pins

NOW ON ALL SUPERIOR DIE SETS IN DIAMETERS FROM 1½" UPWARD AT NO ADDITIONAL COST.

SUPERIOR
DIE SET CORP.
2754 SO. 19TH STREET MILWAUKEE, WISCONSIN
AND CHESHIRE, CONNECTICUT

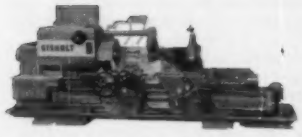
Production Pointers

from GISHOLT

More cost-cutting IDEAS— to help you

ANCHOR EQUIPMENT REDUCES TIME, TOOLING AND HANDLING

Indexing fixture, cross-feeding turret boost productivity 60%



The problems solved with this setup may be similar to those you face. Anchor Equipment Company, San Francisco, Calif., wanted to reduce tool costs, multiple setups, in-process inventory, and machining time on steel gate valve bodies. Here's how they did it, and improved accuracy as well:

They obtained a Gisholt MASTERLINE® 3L Saddle Type Turret Lathe, with a 42″-swing gapped bed, a 5-position indexing fixture, and a cross-feeding hexagon turret.

The 5-position indexing fixture permits completing all three ends of the 6″, 150-lb. steel gate valve body, shown, in just one chucking (includes two 5° seat areas). A swinging push-button control permits the operator to observe the operation with minimum movement. Fixture jaws change fast to accommodate a variety of work sizes.

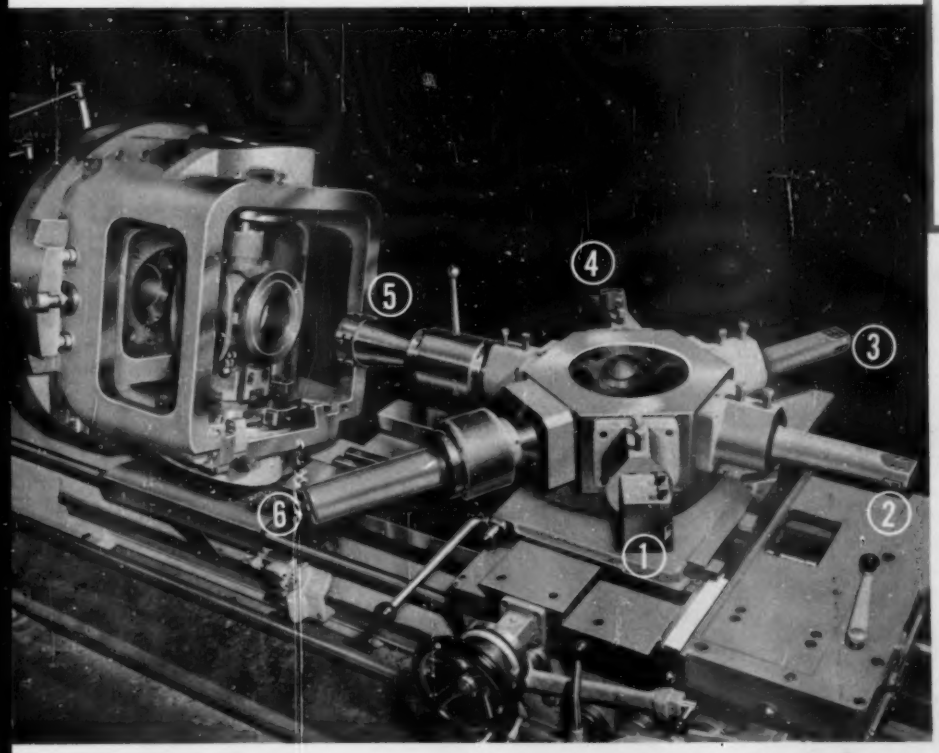
The cross-feeding turret permits use of standard, low-cost boring bars and toolholders. It also permits handling both on- and off-center work (facing, turning, grooving, boring, etc.), eliminating need for a cross slide.

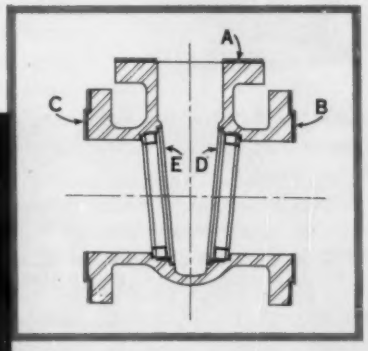
The caption tells how f.t.f. time was reduced 40% on a typical job.

3L cuts time 40%. Cross-feeding hex turret provides versatility, cuts tool costs. Fixture permits completing three ends, two angular seat ring surfaces, and driving of seat rings—all in one chucking.

For information on 3L, circle No. 743 on inquiry card.

Gisholt MASTERLINE 3L tooled for 6″, 150-lb. cast steel gate valve cuts time 40%. Basic setup handles valves 4″, 150-lb., to 10″, 300-lb. Hex 1 tools can serrate raised face of run flanges, and hex 3 tools can finish-face seat rings in place, if required.

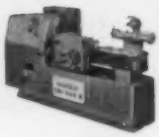




Machining sequence on 6″ steel gate valve body: Hex 1—face A, index fixture 90°, face B, index 180°, face C. Offset fixture, index to 5° seat position, rough- and finish-bore and face D from hex 2 and 3. Form relief and chamfer—hex 4. Index to opposite 5° seat position; use reverse feed (standard on Gisholt Saddles); repeat operations on E from hex 2, 3 and 4. Use reverse lead and reverse spindle, thread E from hex 5. Index to opposite 5° position; thread D with forward lead and spindle, and second set of chasers on same bar—hex 5. Drive seat ring—hex 6 (adjustable torque release on driver simplifies operation). Index again, reverse spindle, drive opposite seat ring. One machine boosts total production 60% over previous method using three older machines.

HOW MACK TRUCKS, INC., SAVES TIME BY COMBINING OPERATIONS

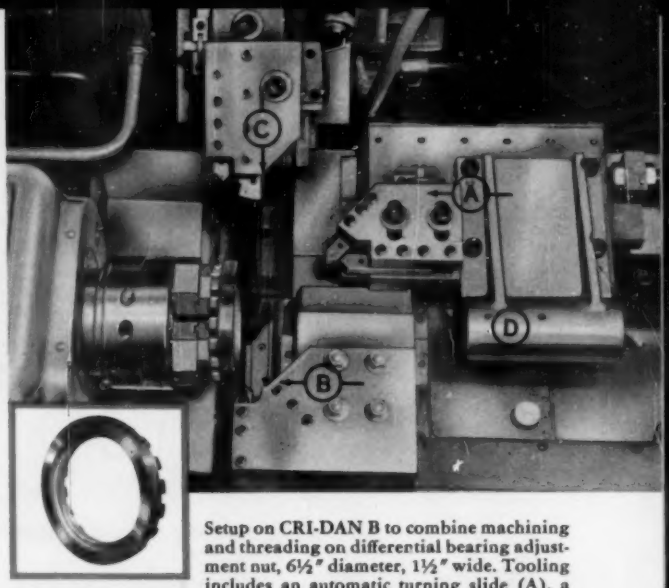
Small CRI-DAN B threads work beyond normal range of die heads



If you're looking for ways to head off rising costs, study this setup used by Mack Trucks, Inc., Plainfield, N. J. It shows how you can combine standard machining with single-point threading on the Gisholt CRI-DAN Threading Lathe. In this case, machining and threading times were slashed an average of 60%...work-handling time and floor space were cut in half...and, with all operations completed in one chucking, quality has improved substantially.

The setup, shown at right, handles a variety of over ten cast iron adjustment nuts. Previously, two machines were required: one to machine, the other to mill the thread. To see how CRI-DAN lets others do it for less, study the one-cycle, combination job sequence at right.

Cost-alert management is vitally interested in equipment that can perform like this. Contact your Gisholt Representative or circle No. 744 on inquiry card for complete details.



Setup on CRI-DAN B to combine machining and threading on differential bearing adjustment nut, 6½" diameter, 1½" wide. Tooling includes an automatic turning slide (A), a standard front threading slide (B), an automatic facing slide (C). The part is located against driving lugs and is chucked in rough bore.

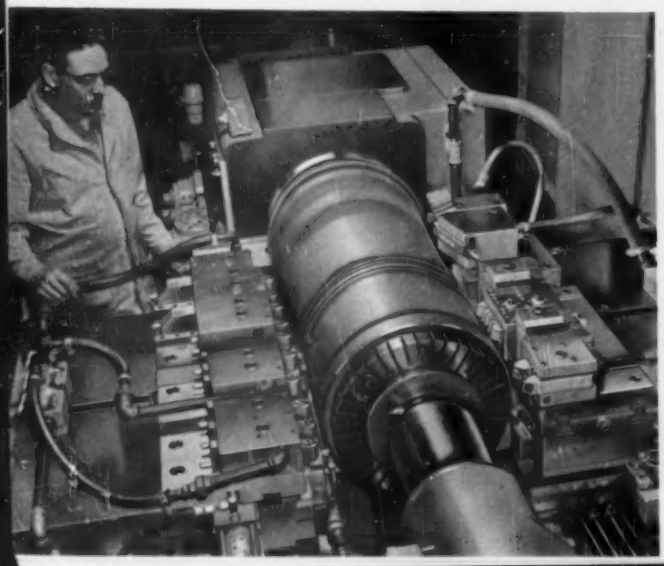
Automatic cycle: Slide (A) tools turn and chamfer O.D.; single-point threading tool on slide (B) produces 12 t.p.i., .054"-deep thread on O.D. in 18 passes, with .003" tool in-feed per pass. A second "feathering" tool on slide (B) removes a portion of first revolution of thread to eliminate possibility of turning over or breaking off; slide (C) tools face front and chamfer rear O.D. edge. Time: only 106 seconds, f.t.f. A revolving center can be mounted in bracket (D) for parts requiring additional support.

INGERSOLL-RAND BOOSTS PRODUCTIVITY ON LINERS

No. 24 Automatic Lathe machines 20 surfaces with tandem tool slides

Here's how an automatic lathe gives you maximum efficiency in machining multiple surfaces on long parts. First, and most important, is that the machine itself offers the right combination of capacity, horsepower, rigidity, versatility and quick change-over to cut costs.

These were the factors involved in Ingersoll-Rand's decision to purchase a Gisholt MASTERLINE No. 24 Automatic Lathe for cylinder liner machining in their plant at Painted Post, New York. The machine shown, is a second No. 24 recently ordered to meet increased production needs.



Work includes liners from 24¾" to 43" in length, 18" to 21½" diameter, in lots up to 100 pieces. Up to 20 O.D. surfaces must be rough- and finish-machined.

The work is supported on expanding mandrels at headstock and tailstock. Front and rear carriages are extra wide. Each carriage supports two independent tool slides, linked together to operate as a unit. Separate setups are made for roughing and finishing. The slide tops are accurately marked for fast positioning of blocks with preset indexable tip tools. Size adjustment is provided for each tool. Cam-operated tool blocks, actuated by forward movement of the carriage, are used where tapers are required.

A 100 h.p. motor and the rugged No. 24 headstock permit simultaneous engagement of all 22 tools for the roughing operation on the 20½"-diameter, 43"-long liner shown. These tools turn, taper-turn, blend, face, groove and chamfer. Setup is similar for the finishing operation. Machine rigidity permits holding tolerances of +.005" to −.000" on the 43"-long parts.

Twenty-two tools machine 20 surfaces during the automatic roughing cycle. Up to 30 pieces are completed per tool despite heavy stock removal.

No. 24 saves time, improves accuracy over entire work range. It offers capacity and flexibility for maximum savings on large parts.

For information on No. 24, circle No. 745 on inquiry card.

GISHOLT® MACHINE TOOLS SINCE 1887

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

SUPERFINISH® SAVES TWO OPERATIONS FOR SKF

Eliminates grinding, finishes a face and a diameter at the same time

Superfinish offers a lot more than a fast, automatic cycle that produces a "controlled" surface finish at minimum cost. Other important benefits that will assure top management approval when making your new equipment requests are demonstrated by this setup used by SKF Industries, Inc.

Benefit No. 1—Eliminates and combines operations

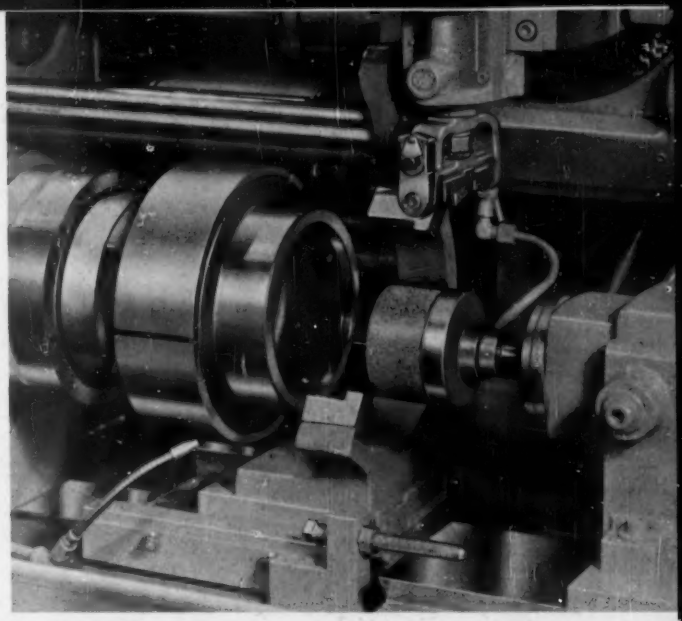
Here a Model 51A Superfinishes two surfaces on cast iron railroad axle caps. These surfaces are first machined, then Superfinished. Grinding is eliminated. The upper stones engage the seal diameter and remove .003″ stock while reducing the surface from 150 to 20 micro-inches RMS. *At the same time*, the cup wheel on the rotary quill Superfinishes the induction-hardened roller thrust face from 150 to 15 micro-inches RMS. A .005″ taper is also created on the thrust face.

Benefit No. 2—Improves surface quality for longer service life

Minute peaks that cause excessive wear or galling are removed. The true bearing area is increased as much as 80%. Some valleys remain to retain lubricant. Load capacity is increased substantially.

Benefit No. 3—Versatility and quick setup

SKF uses one machine to Superfinish both flat and cylindrical surfaces on axle caps, enclosure collars and sleeves in a variety of sizes. Expanding mandrels and face-plate fixtures hold the work. Stone pressure, reciprocation rate, rough and finish spindle speeds, and cycle times are quickly set for each part. Quick-change stone holders further simplify the operation. Longitudinal traverse for long diameters is available.



Axle cap shown in mandrel. Note loading and locating fixture at front center. Stones on overhead quill Superfinish 6.750″-diameter, 1-21/32″-wide seal surface, while the cup wheel, on a rotating quill, advances to Superfinish the roiler thrust face. Two operations performed in one chucking.

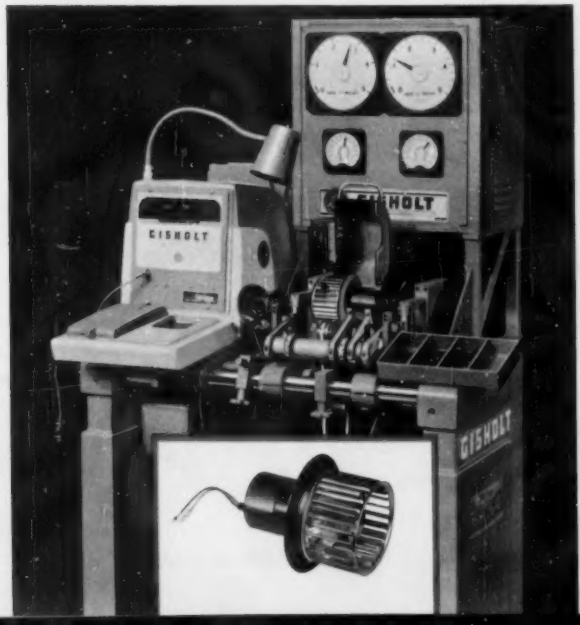
Superfinish cuts previous finishing time in half on part shown, saves in other three major areas. Contact Gisholt for a complete analysis of possible savings on your work.

For information on Superfinishing, circle No. 746 on inquiry card.

HOW YOU CAN SIMPLIFY PRODUCTION BALANCING

NEW ideas reduce work handling, speed production, eliminate chance of error

This setup on a 1S Balancer may point the way to new speed, efficiency and accuracy in your own balancing operations. Featuring several new ideas, this 1S locates, measures, corrects and inspects balance of blower assemblies for automotive air conditioners—all in one fast cycle. A battery of 13 such machines is cutting costs for a well-known eastern automotive components manufacturer.

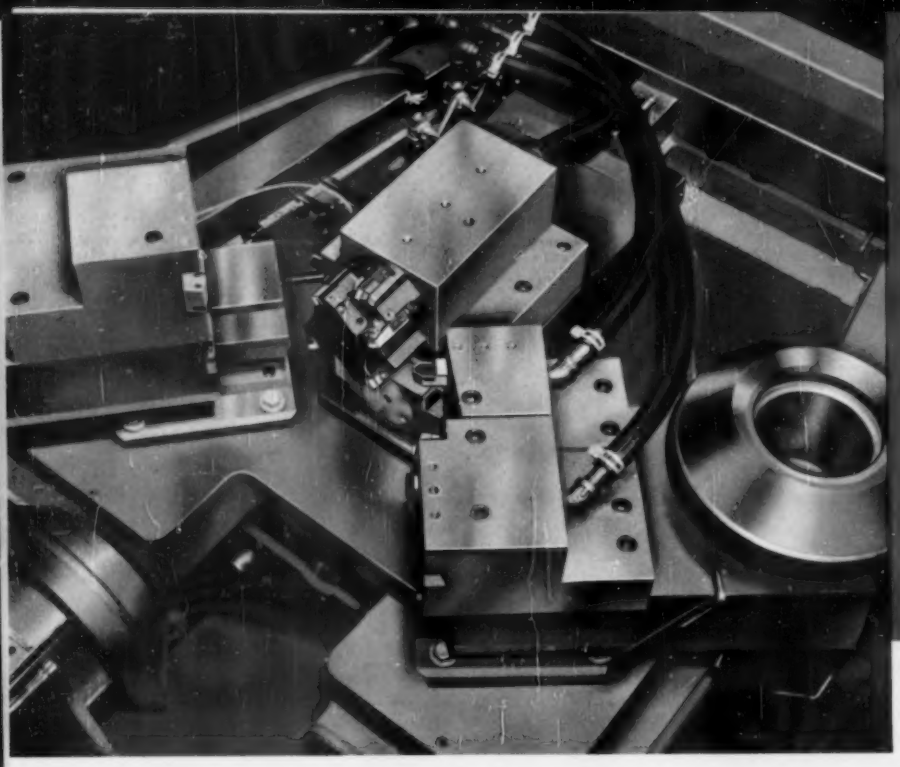


Operating and work-handling time is cut to a minimum by: a direct-loading supporting fixture which works without clamps or half-bearings; a belt drive under the work which eliminates belt-handling; a slip-on scanning cup which eliminates the usual numbered angle reference tape or protractor on the work; a single "left-right" switch which quickly indicates angle and measures amount of unbalance in each plane; separate unbalance location (angle) and amount meters that "hold" readings until corrections are made—one set for each correction plane; automatic starting and stopping of work rotation by raising and lowering of protective shroud. Guesswork is eliminated since meters provide exact indications in terms of correction method used.

Before loading, operator places a scanning cup inside the fan on the hub. Aluminum clips (various weights in tray) are crimped to the vanes at indicated angles in each plane to correct unbalance. The amount meter shows the clip size required to correct within a 1/64 oz. in. tolerance. With this setup on the Gisholt 1S Balancer, one operator locates, measures, corrects unbalance and inspects 74 blower assemblies per hour.

New ideas speed and simplify balancing—eliminate need for operator to remember angle and amount of unbalance in each correction plane.

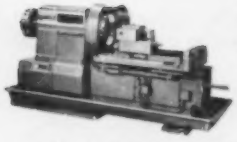
For information on 1S Balancer, circle No. 747 on inquiry card.



Bevel pinion is held on an expanding mandrel. Platen advances tools to work and holds while front slide straddle-faces back angle and face; center slide co-bores; rear slide faces front angle. Time: 3.3 minutes, f.t.f.

THE AUTOMATIC WAY TO HIGHER PROFITS ON YOUR PARTS

Simplimatic® offers "one-pass" completion of second-operation work



Whether you machine bevel gears or not, you can benefit from the ideas used in this setup. It shows how a Gisholt MASTERLINE Simplimatic, a single-spindle automatic lathe, can be tooled to machine a maximum number of surfaces per chucking—providing consistent quality at fixed production rates — leaving the operator free to handle a second machine.

The overhead view of the tooling used in the second operation on steel bevel pinion forgings demonstrates the versatility of this machine. Note the wide platen. Retracted, it provides ample clearance for loading and unloading. The platen is screw-fed and carries the tools to and from the work. It can rapid-traverse, and then hold while the slides operate. It can also rapid-traverse, then feed forward to plunge facing tools to depth; it can bore or position tools in a bore for straddle facing, internal grooving, etc., before standard slide movements begin.

In this setup, front, center and rear independent slides operate simultaneously. All are positioned so that when the platen advances to machining position, they will be close to the work, at the proper angles, and will have minimum tool overhang.

A 40 h.p. motor permits heavy stock removal (angle facing cuts at 250 s.f.m. and .015″ feed, up to ½″ stock removed per side). Machine and tooling rigidity assures accuracy on angles and good surface finish.

For your own work, a tailstock, a separate motor-driven speeder boring bar, a single- or multiple-pass JETracer® slide or an auxiliary slide can be mounted on the platen. A back-facing or back-boring attachment can be operated through the spindle—permitting simultaneous machining of front and back surfaces.

A basic set of tooling can generally be provided to handle a number of work sizes—even parts of quite different configuration—with minimum time for change-over.

Versatile Simplimatic does the work of special machines at standard machine cost. Platen permits unlimited variety of tool slide arrangements for machining maximum number of surfaces per pass.

For information on Simplimatic, circle No. 748 on inquiry card.

Ask about Gisholt "Productivity Team"

Almost any part can be handled at peak efficiency with a "Productivity Team" consisting of an automatic turret lathe and single-spindle automatic. With fast, new setup and change-over advantages, they are now practical for small lots as well as for large production runs.

Gisholt now offers automatic turret lathes in six sizes and four single-spindle automatics. Call your Gisholt Representative. Let him show you how a new Gisholt "Productivity Team" can cut costs on your work.

GISHOLT

MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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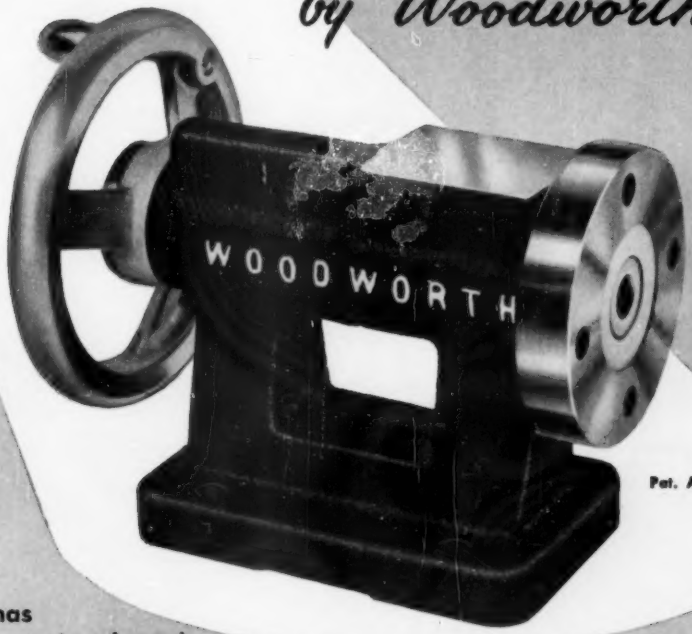

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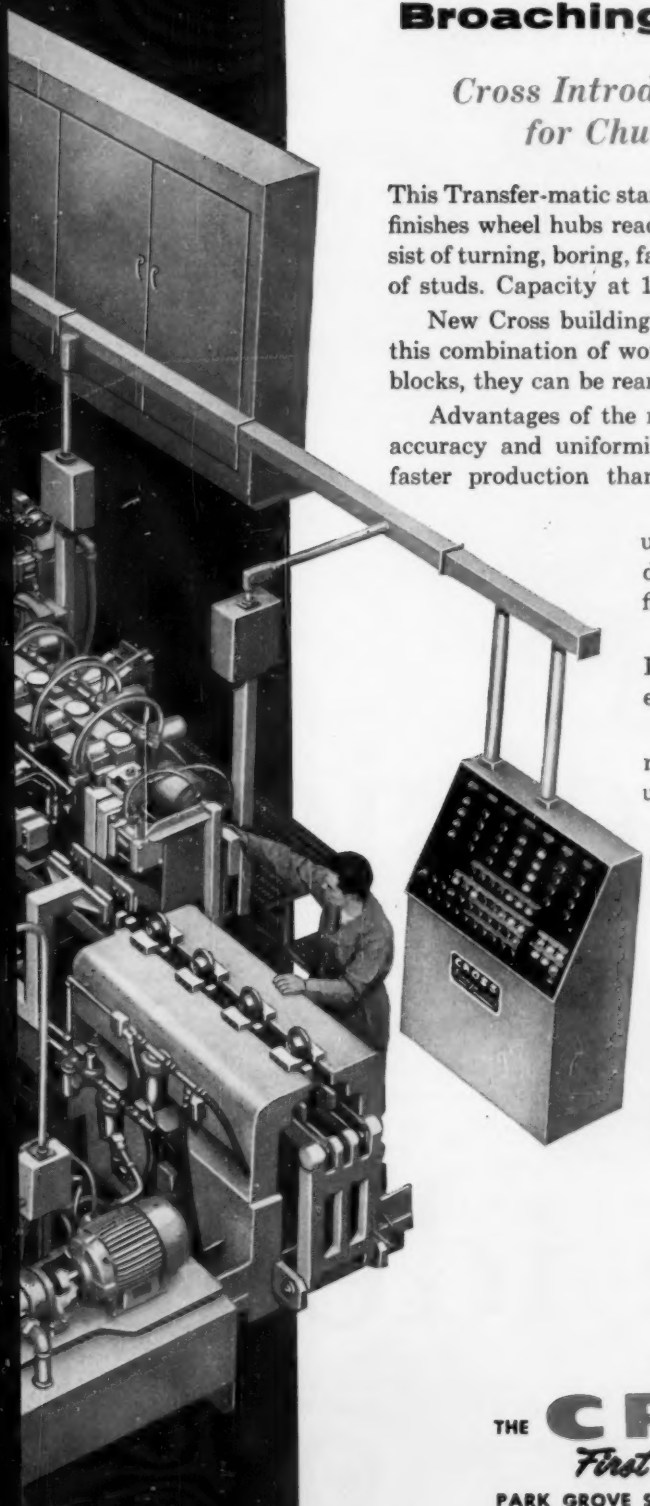
Tool slides are rotated to the upward position so tools can be seen, reached and replaced easily.

Another Automation First by Cross

New Transfer-matic Combines Chucking with Drilling, Broaching and Assembly

Cross Introduces Building Blocks for Chucking Operations



This Transfer-matic starts with rough castings and completely finishes wheel hubs ready for final assembly. Operations consist of turning, boring, facing, drilling, broaching, and assembly of studs. Capacity at 100% efficiency is 200 parts per hour.

New Cross building blocks for chucking operations make this combination of work possible. Like other Cross building blocks, they can be rearranged as requirements change.

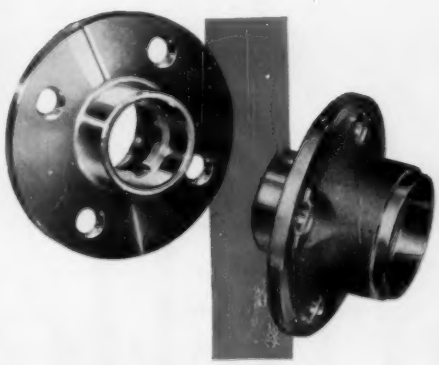
Advantages of the new Transfer-matic include maximum accuracy and uniformity, higher output, less handling, and faster production than conventional methods.

Heavy duty, three jaw chucks are used on the roughing operations but diaphragm types are employed for finishing to avoid clamping distortion.

A work bank between Sections I and II permits independent operation of either one during maintenance.

The new building blocks include a novel slide unit which tilts the tools upward to speed changes.

Cross engineers will gladly discuss details of this Transfer-matic with you.



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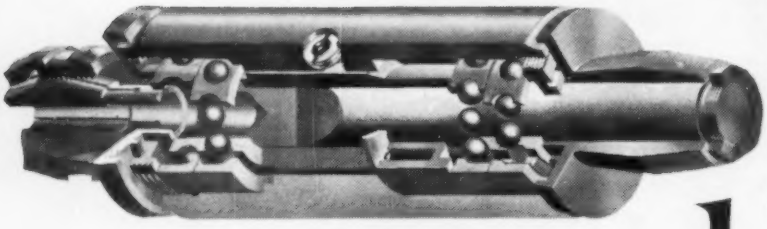
THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

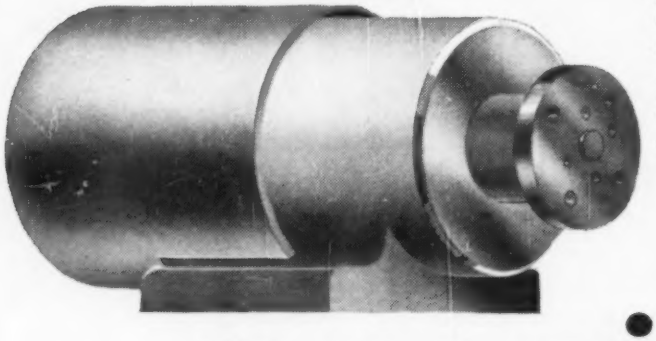
To the nth degree:

accurate



Whitnon spindles are known for accuracy in every aspect: accuracy in machining of all their parts to fine tolerances, accuracy in the application of the finest bearings, accuracy in the use of spring preloading. This view of a Whitnon precision grinding spindle, series B-235, shows the basic concept which has made Whitnon spindles outstandingly dependable.

rugged *for full production*



Whitnon's D-475 is motorized, fan-cooled, grease-lubricated and sealed for life. Adaptable to heavy-duty milling and face or disk grinding, it is available in sizes ranging from 10 HP @ 1800 rpm to 25 HP @ 3600 rpm. It can be provided with electric braking, and with optional tool-mounting specifications to suit your needs.

precision

where precision counts:

Whitnon

All Whitnon spindles — large or small — have a superior level of precision *designed in,* to assure dependability in high-production applications . . . because Whitnon designers are not just engineers; they're also practical master-machinists who *know* how machine tools behave under load, because they've used them. See for yourself. Ask for Whitnon's useful catalog of precision spindle ideas.

spindle ideas

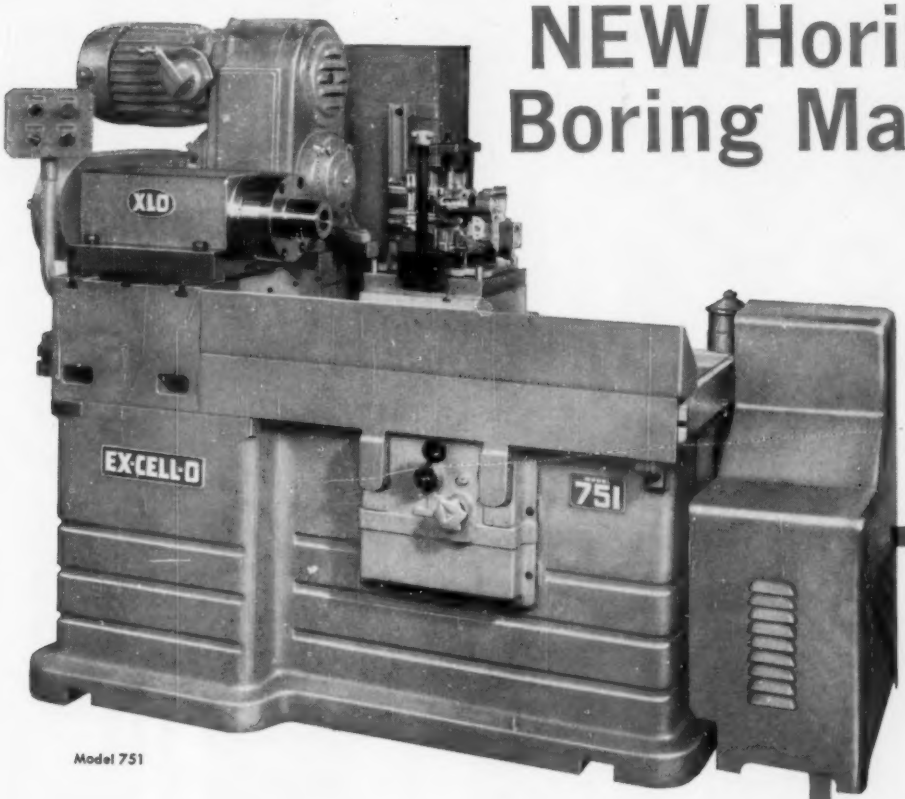
The Whitnon Manufacturing Company, Route 6 and New Britain Avenue, Farmington, Connecticut.
Specialists in the design and manufacture of precision revolving machinery.
24-hour repair facilities in Farmington and at The Whitnon Spindle Company, 20466 Wyoming Avenue, Detroit.

Use Reader Service Card, CIRCLE 18

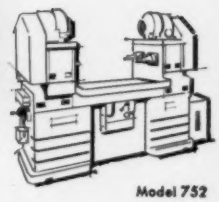
Use Reader Service Card, CIRCLE 17

EX-CELL-O ANNOUNCES...

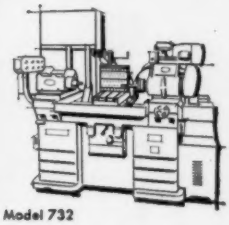
NEW Horizontal Boring Machines



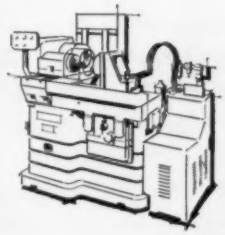
Model 751



Model 752



Model 732



Model 731

Designed and built for maximum dimensional stability under all operating conditions, these new hydraulically operated precision boring machines offer the ultimate in accurate repeatability.

Check these features for production efficiency . . .

- Temperature controlled hydraulic panels
- Extreme rigidity and stability in bases and tables
- Hydraulic and coolant system externally mounted
- Ex-Cell-O standard and tapered roller bearing spindles
- Designed for close-tolerance precision boring, turning, facing, counterboring, chamfering, grooving, recessing and trepanning operations.
- May be operated either manually or automatically.
- Engineered for simple installation into automated production lines.

Contact your Ex-Cell-O Representative or write direct for details.

60-66

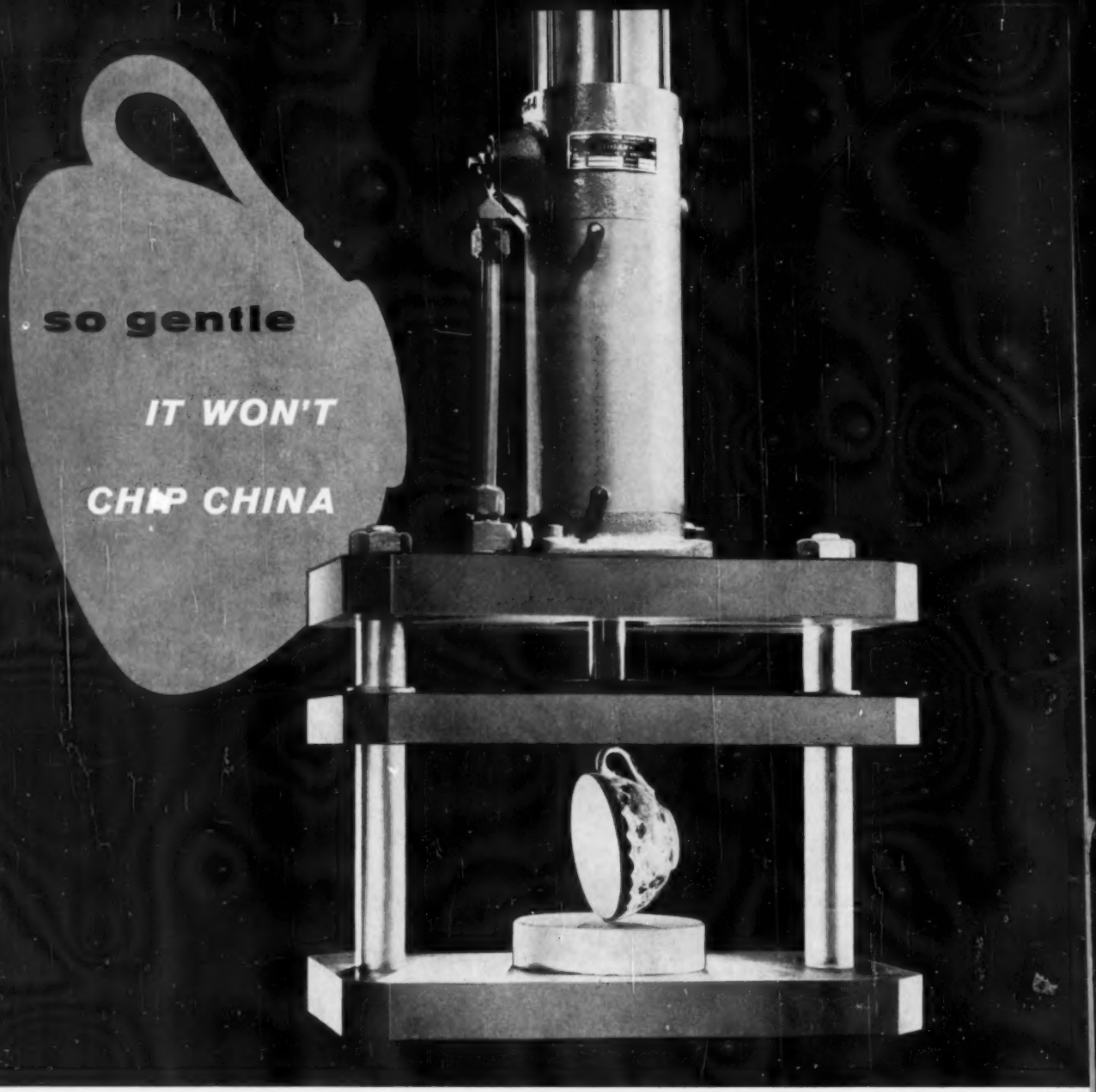
EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN



So gentle it won't chip china, yet powerful enough to bend steel tubing as if it were a soda straw. In a nutshell, this demonstrates the almost unbelievable degree of control built into Logan air-draulic devices.

The controlled accuracy gives this equipment a versatility and flexibility that makes it adaptable to all kinds of jobs, ranging from precision laboratory assignments to actual production line work.

If you would like additional information about air-draulic devices or other Logan products, merely fill in the coupon below.

LOGAN
AIR AND HYDRAULIC OPERATED MACHINES

Check the items you want, fill in your name and address, tear out and mail to:

Logansport Machine Co., Inc. • 740 Center Avenue, Logansport, Indiana

__100-1 AIR CYLINDERS
__100-2 MILL-TYPE AIR CYLS.
__100-3 AIR-DRAULIC CYLS.
__100-4 AIR VALVES
__100-5 LOGANSQUARE CYLS.
__100-6 ULTRAMATION CYLS.
__100-7 SUB-PLATE AIR VALVE
__300-1 CHUCKS
__300-2 PRESSES
__200-1 HYD. POWER UNITS
__200-2 ROTOCAST HYD. CYLS.
__200-3 750 SERIES HYD. CYLS.
__200-4 and 200-7 HYD. VALVES
__200-6 SUPER-MATIC CYLS.
__ABC BOOKLET
__CIRCUIT RIDE
__CALCULATOR
__FACTS OF LIFE

Please send copy of catalog

NAME.....

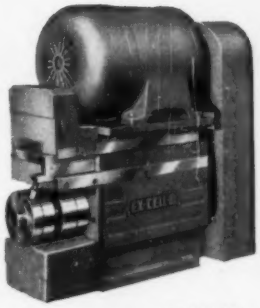
TITLE.....

COMPANY.....

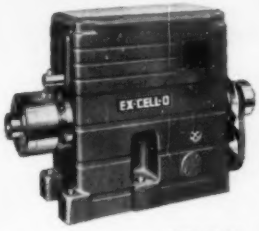
ADDRESS.....

IMMEDIATE DELIVERY

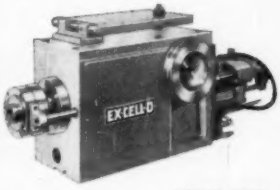
STYLE 28-A
HYDRAULIC POWER UNIT



STYLE 22
HYDRAULIC POWER UNIT



STYLE 20
HYDRAULIC POWER UNIT



STYLE 502
LEAD SCREW TAPPING UNIT

Ex-Cell-O Hydraulic Power Units in Stock Now to Cut Your Machine Tool Lead Time and Production Costs!

Reduce lead time, increase productivity, and cut per-unit cost with Ex-Cell-O Quill-Type Hydraulic Power Units—immediately available for drilling, counterboring, spot-facing, and reaming operations, or as prime movers for milling equipment.

Ex-Cell-O Hydraulic Power Units are self-lubricated . . . built for easy installation, and trouble-free operation, even under fast cycles and continuous production. Compactness allows close center distance installation, in-line or radial . . . versatility makes them ideally suited for special-purpose, high production machines. A companion product, the Style 502 Tapping Unit, uses a lead screw for trouble-free tapping.

See your Ex-Cell-O representative or write direct for full information on the complete line of Hydraulic Power Units and our Canadian-built Lead Screw Tapping Unit.

EX-CELL-O FOR PRECISION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Machinery Division

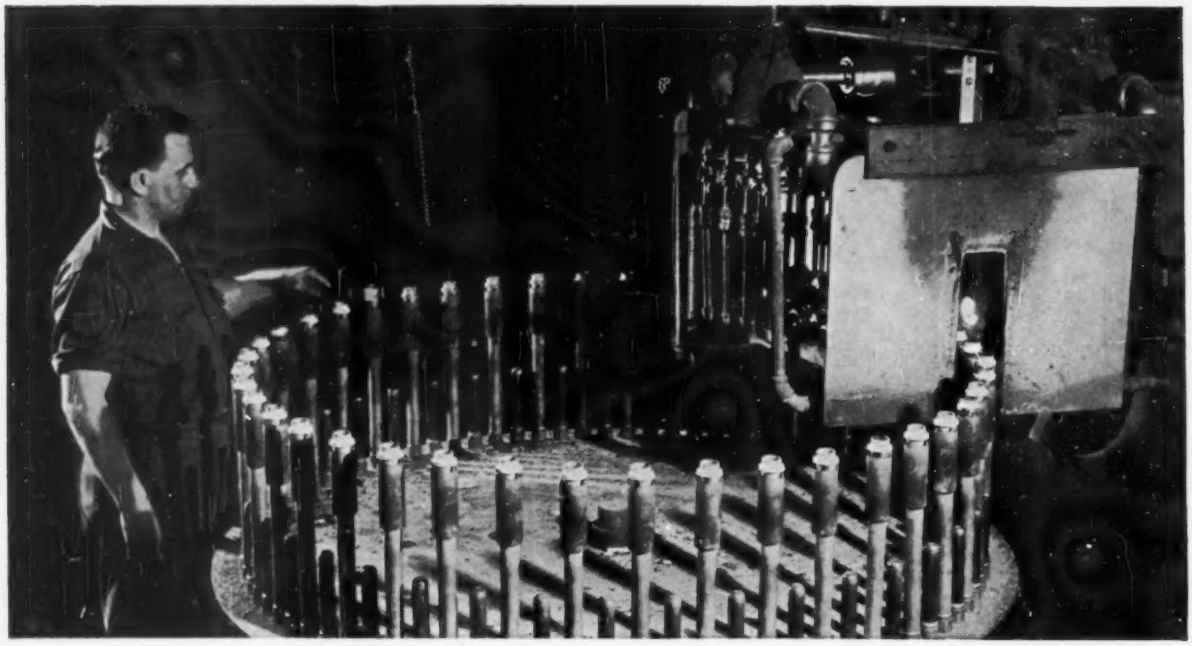
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

60-42

Use Reader Service Card, CIRCLE 20

Use Reader Service Card, CIRCLE 21

Every Hour M. S. Little Brass Goods Company Makes 650 Appliance Fittings Better With **HANDY & HARMAN SILVER BRAZING**



Rotating jig showing mounted assemblies entering and leaving gas-air furnace.

Left– brazed assembly. Right– components with preform ring of EASY-FLO *45.*

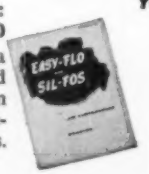
This Hartford, Connecticut, company makes—in volume—an assembly that goes into the overflow system of household appliances. The assembly consists of brass tubing and a machined brass casting. The two components are joined by a preplaced ring of Handy & Harman EASY-FLO 45 silver brazing alloy and HANDY FLUX. Heating is automatic gas-air; parts are placed on a rotating turntable to pass through the gas furnace. Every 60 working minutes, 650 assemblies are completed.

The advantages here are that the manufacturer can use thin-walled tubing with heavier, threaded components at no sacrifice in strength. Because of EASY-FLO's penetrating qualities, the entire shear area is fully as strong as the solid parts of the assembly, yet considerably lighter. And, casting and machining the components for this assembly have been greatly simplified.

Are you in pursuit of a metal-joining method which offers—among other advantages—high, uninterrupted production at low capital investment? You may easily find the answer in Handy & Harman silver brazing. Hundreds of manufacturers and fabricators of as many different products, parts and components are right now enjoying the speed, economy, strength and *flawlessness* of brazing. You can too. Just ask Handy & Harman, 82 Fulton Street, New York 38, N. Y.

FOR A GOOD START: BULLETIN 20

This informative booklet gives a good picture of silver brazing and its benefits . . . includes details on alloys, heating methods, joint design and production techniques. Write for your copy.



Your No. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

DISTRIBUTORS IN PRINCIPAL CITIES

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Bridgeport, Conn.
Chicago, Ill.
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Los Angeles, Calif.
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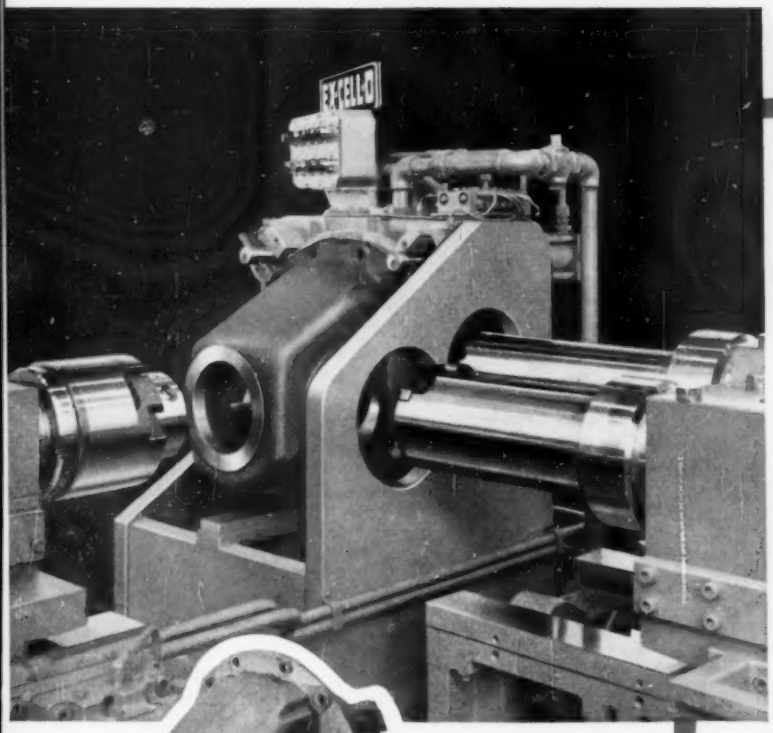
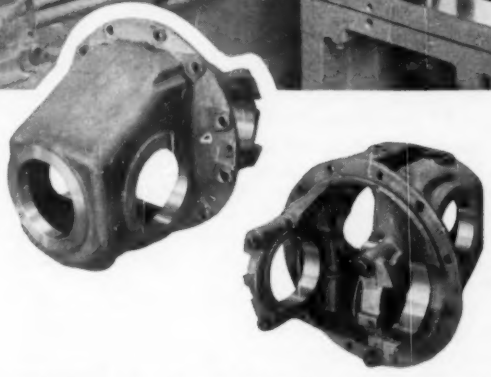
Providence, R. I.
San Francisco, Calif.
Montreal, Canada
Toronto, Canada

Ex-Cell-O Custom Machines Specialize in Difficult Jobs!



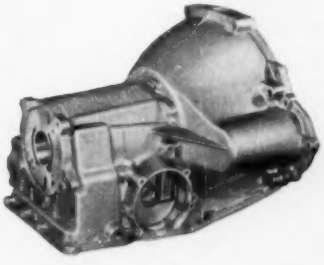


Whether you have a simple job that must be done faster and more accurately, or complex work that requires multiple machining operations, an Ex-Cell-O Custom Machine may be just the answer you've been looking for . . . the economical solution to a difficult production problem.

See your Ex-Cell-O Representative, or contact Ex-Cell-O's Machinery Division in Detroit for details on the limitless applications of Ex-Cell-O Custom Machines.

HEAVY-DUTY BORING—Custom Boring Machine uses three heavy-duty Ex-Cell-O Precision Spindles to simultaneously finish-bore four holes and bore-and-face a fifth hole in this 75-pound cast-iron housing in a 4½ minute cycle. Diameters are about 6"; tolerances are held within .001".

MULTI-DIAMETER BORING—In a single cycle, the long boring bar on this Custom Machine line-bores two holes while shorter bar below it bores a third diameter, and small spindle in foreground bores a dowel hole in this huge clutch and gear housing.



HIGH PRODUCTION—Aluminum transmission case shown above is turned 90°, rolled over 180° as it passes through a 24-station Custom Machine. Automatic operations include precision boring, facing, chamfering, radial milling, tapping, trepanning, air gaging and flushing. Output is 124 parts per hour.

EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • RAILROAD PINS AND BUSHINGS • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

60-31

Use Reader Service Card, CIRCLE 23

NO DOUBT ABOUT IT...

that's why the DIMENSIONAIR is the best air gage you can buy!

No doubt about the Dimensionair's readings

Such sharply defined calibration — the mark of a truly accurate gage — obviously gives you greater resolution, much finer readings than broadly defined graduations and wide hands or air-suspended markers ever can. Each time you gage with the Dimensionair, the needle-thin indicating hand advances smoothly, comes to a positive stop, yet is responsive to the slightest change. Its position in relation to the fine-line graduations is unmistakable. Such decisiveness, coupled with Dimensionair sensitivity, means much greater readability. In fact, tests prove that you get more information from the Dimensionair than from other air gages having *twice* the magnification.

No doubt that the Dimensionair maintains its accuracy

Dimensionair magnification is built-in . . . fixed. No adjustment can change it. That's why the Dimensionair, once set, *stays* set. Air pressure variations cannot affect the accuracy of the Dimensionair. Its balanced air circuit cancels them out. This achieves a stability which cannot be approached by other air gages.

No doubt the Dimensionair is easiest to use

Its fixed calibration and protection against drift guarantees *linear, calibrated* accuracy so you need only *one* master for set-up . . . make only *one* adjustment to set zero. You're ready to gage in less than ten seconds . . . no juggling high and low limits as with other air gages. Dimensionair design gives you wide range operation (up to .006" depending on model selected).*

All these advantages are yours because the Dimensionair, unlike other air gages, is *built* to a specific accuracy and magnification. But don't just take our word for it . . . see for yourself. We shall be glad to demonstrate the Dimensionair to you.

*FIVE MAGNIFICATIONS TO CHOOSE FROM:

1,250:1 (.006" range, each grad. = .0001")
2,500:1 (.003" range, each grad. = .00005")
5,000:1 (.0015" range, each grad. = .00002")
10,000:1 (.0006" range, each grad. = .00001")
20,000:1 (.0003" range, each grad. = .000005")

FEDERAL PRODUCTS CORPORATION
1191 Eddy Street · Providence 1, R. I.

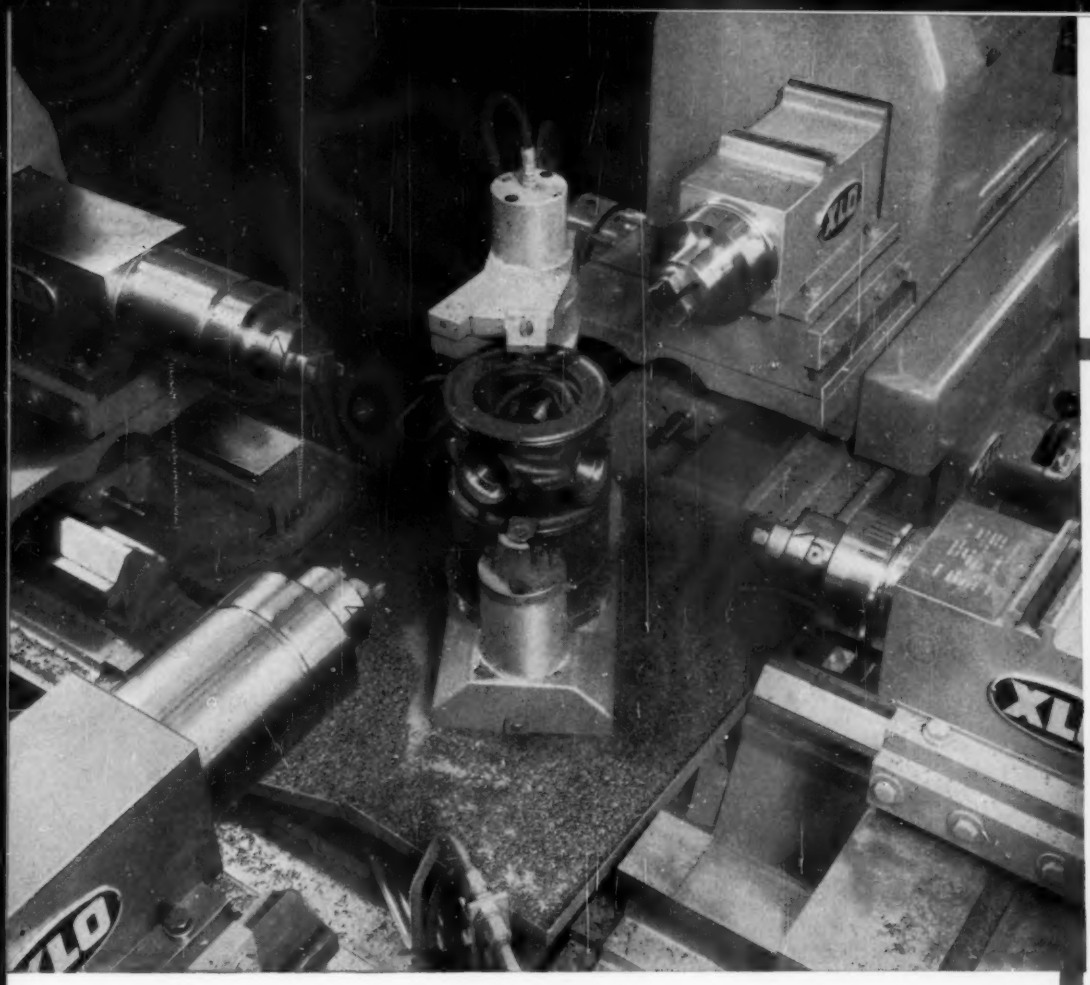
Yours for the asking!
"DIMENSIONAL GAGING WITH AIR"

A truly educational film — 16 mm, 40 minute, color — outlines the basic principles of air gaging — shows applications. A must for anyone involved with dimensional control. Puts the value of air gaging in the proper perspective. Write for reservation.

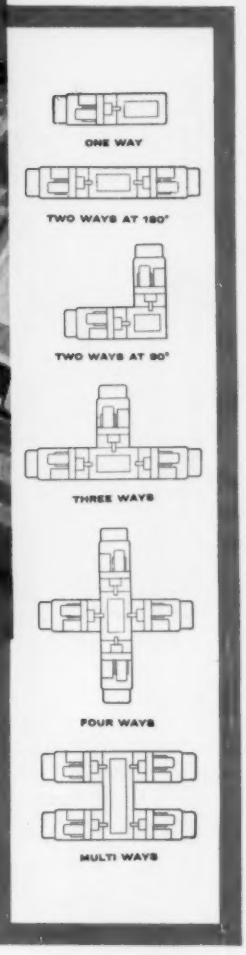
Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging



TYPICAL
"BUILDING BLOCK"
ARRANGEMENT



4-Way Production Savings with Ex-Cell-O Way Machines

1 **LOWER COST** Each Ex-Cell-O "Building Block" Way Machine Unit has standard base, table slide and complete, inbuilt hydraulic system. You can specify only the standard spindles or accessories that meet your present needs. 2 **INCREASED FLEXIBILITY** One Way-type unit gives you a basic, versatile precision boring machine; as operations become more complex, simply add one or more Way units to a common end section to multiply production or machining functions. 3 **MORE VERSATILITY** Ex-Cell-O Way Machines permit precision boring, turning, facing or grooving, chamfering or counterboring—with or without automatic cycles, work indexing or clamping. 4 **GREATER CAPACITY** Using simple fixtures, you can rough or finish-machine larger, heavier work than possible on most standard boring machines.

Ask your Ex-Cell-O Representative about savings with Way-type Machines, or write direct for details.

Typical setup shows four units positioned at 90° for simultaneous rough boring, counterboring and trepanning. Beds, tables, center section, hydraulic systems, controls and Ex-Cell-O Precision Spindles are standard components. Units can be rearranged at any time.

60-29

EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • RAILROAD PINS AND BUSHINGS • DAIRY AND OTHER PACKAGING EQUIPMENT

XLO

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Use Reader Service Card, CIRCLE 24

Use Reader Service Card, CIRCLE 25

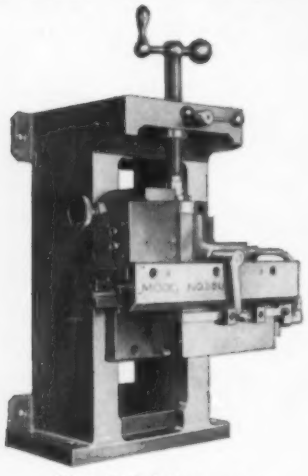
Engineered Marking by CADILLAC . . . *cuts costs*

CADILLAC Builds the Most Complete Line of STANDARD HYDRAULIC and PNEUMATIC MARKING MACHINES

CADILLAC leadership has been established through the development of sound engineering and efficient low-cost marking machine operation and maintenance.

Through simplicity of design, CADILLAC Marking Machines are available in price ranges that meet the demands of cost-conscious buyers.

Shown here are four of the Standard CADILLAC Marking Machines. Highly efficient, they can be installed in your automatic or automated production setup . . . assure permanent product marking. CADILLAC also designs and builds Special Marking Machines, tooling and fixtures, to meet every conceivable marking requirement.



Write for Bulletin No. 58U.

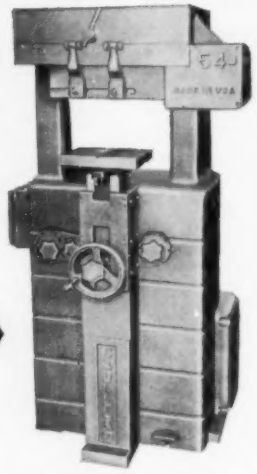
CADILLAC NO. 58U HYDRAULIC MARKING UNIT

Meets the needs of automatic and automated production processes for a standard marking unit—can be mounted in any position—upside down . . . sideways . . . or at any angle. The only completely hydraulic marking unit, employing the roll marking principle, that permits the marking of parts while in a fixtured position.

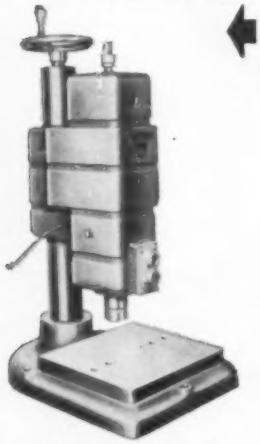
Also available with our standard base and complete with built-in oil reservoir, oil filter, motor and pump system pressure regulator, foot actuator, and all electrical controls.

CADILLAC NO. 54 HYDRAULIC MARKING MACHINE

Here single pressure control regulates full range of pressures—marks round, flat and irregular surfaces. Can mark a very light legend into nonferrous metals . . . extremely deep legends into tough steels. It is ruggedly built and simple to operate.



Write for Bulletin No. 54.



Write for Bulletin No. 52.

CADILLAC NO. 52 AIR IMPACT PRESS

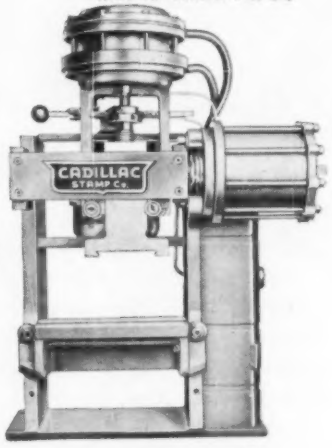
Can be furnished in bench or floor style models. Has built-in features, including positive air and electric safety controls. Highly versatile for—

MARKING	•	BRANDING
STAKING	•	CRIMPING
PIERCING	•	CUT-OFF

COLOR MARKING

CADILLAC NO. 60-U PNEUMATIC MARKING MACHINE

Meeting the needs for a low-cost, power operated roll marking machine, it offers high speed production, low initial cost, and completely automatic work cycle. Can be easily operated in conjunction with a rotary feed table or in an automated line . . . can be mounted in any position desired. Also available with CADILLAC standard base.

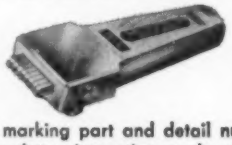


Write for Bulletin No. 60.

STAMAX ROLL DIES

Developed by Cadillac for the REALLY tough marking job.

HAND HOLDER
INTERCHANGEABLE
STAMAX TYPE INSERTS



For marking part and detail numbers, dates, inspection marks, tool checks, name plates, etc.

CADILLAC MODEL NO. 32
Automatic Numbering Head
(Special Barrel Style Shown)

Perfect for consecutive serial numbering.
Standard Models Available

SPECIAL STAMAX CODE
INSPECTION STAMPS
AND SYMBOLS

Hard and tough — won't mushroom, chip or split. Priced right.

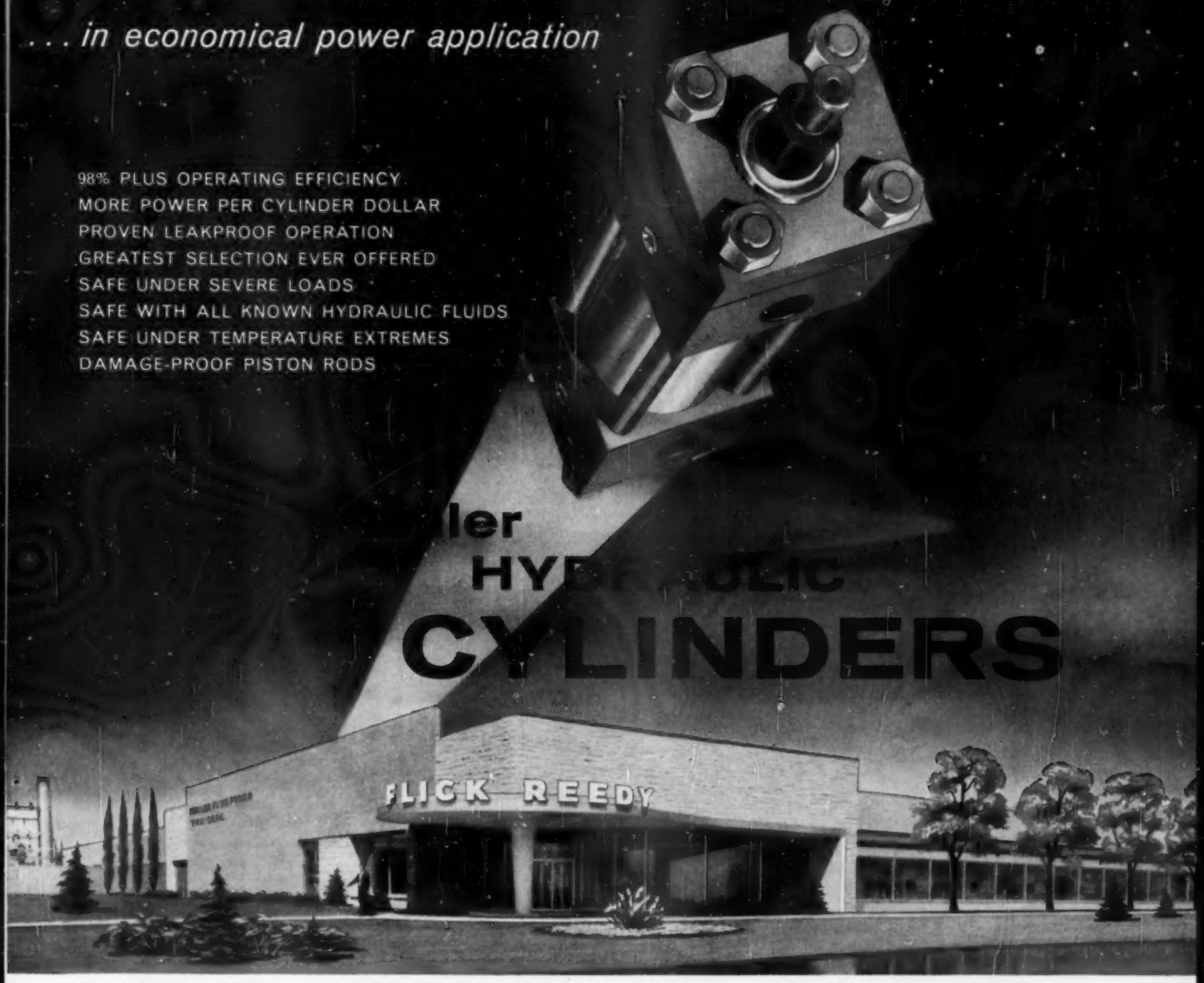
For further information regarding marking devices and equipment, write for Bulletin No. 41.

CADILLAC STAMP CO. Originators of STAMAX Steel Stamps and STAMAX Marking Dies
Corner of RYAN and NANCY • DETROIT 12, MICHIGAN

OPENING NEW HORIZONS

. . . in economical power application

98% PLUS OPERATING EFFICIENCY
MORE POWER PER CYLINDER DOLLAR
PROVEN LEAKPROOF OPERATION
GREATEST SELECTION EVER OFFERED
SAFE UNDER SEVERE LOADS
SAFE WITH ALL KNOWN HYDRAULIC FLUIDS
SAFE UNDER TEMPERATURE EXTREMES
DAMAGE-PROOF PISTON RODS



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Our ultra-modern, new "Plant of the Year" with its special facilities and operating economies enable us to offer an **extra 10% price savings** on our big "stock" selection of:
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Strokes up to 36", cushioned and non-cushioned.

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Miller Hydraulic Cylinders make impossible applications look easy. With Teflon Seals, Case-Hardened Rods (50-54 Rockwell C), Patented "Shef" Tubing End Seals, and other exclusive *standard* features, these cylinders are practically damage-proof, are ultra-dependable under pressure and temperature extremes, and provide leakproof sealing with ALL hydraulic fluids. Built to *exceed* J. I. C. Specifications, these cylinders are achieving new highs in production and operating economies in thousands of plants. Two great lines: Power-Packed Model H for 3000-5000 psi and Job-Rated Model J for 500-2500 psi. All bores, strokes and mounting styles. Big "Stock" selection for immediate shipment at substantial savings.

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DIVISION OF FLICK-REEDY CORPORATION

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AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
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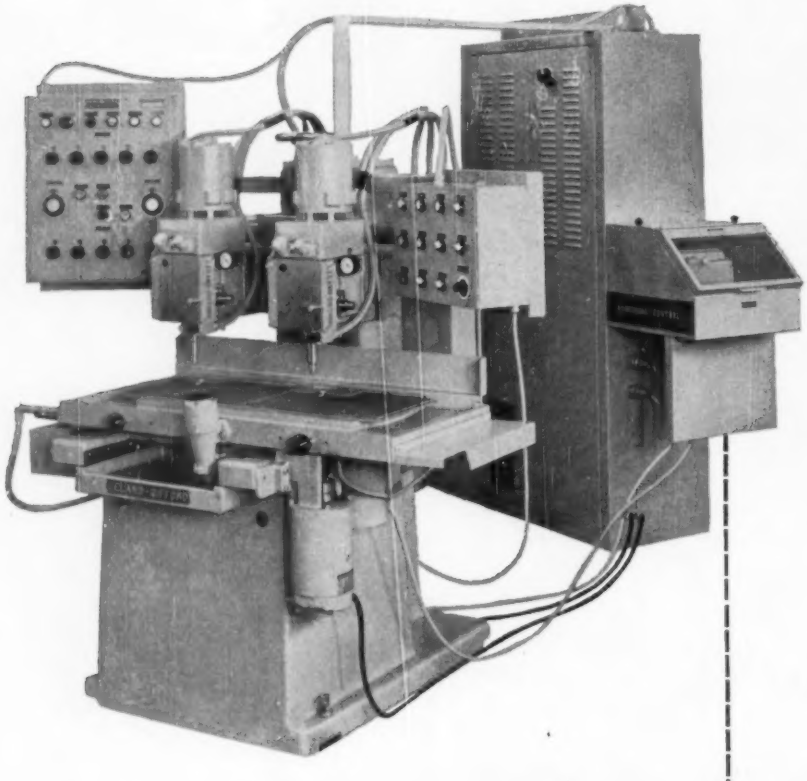
LELAND GIFFORD

PRINTED CIRCUIT BOARD DRILLING MACHINE

Operates in excess of 50 hits per spindle per minute — May be programmed by Flexowriter or direct from Art Work or Sample Board.



FEATURES

- Programmed by Flexowriter or direct from art work or sample board.
- Table position and spindle cycle actuated by G. E. Mark II Numerical Control with fast tape reader.
- Operates in excess of 50 hits per spindle per minute.
- Drills single boards or stacks.
- Up to four adjustably mounted, self-contained, hydraulic feed drilling units can be used.
- Table traversed hydraulically on ball-bearing mounted and guided round ways.
- High speed positioning by self-contained, closed loop, hydraulic circuits and reversible G. E. Thy-Mo-Trol controlled motor driven pump.
- Nation-wide control service available from General Electric Co.

Here is a practical, economical solution to the problems of fast, accurate production of electronic printed circuit boards. Combines the best features of the proven Leland-Gifford HOLE LOCATOR and the universally accepted modified G. E. Mark II numerical positioning control.

Hole patterns can be programmed by Flexowriter or directly from art work or sample board. Table can also be positioned numerically with control dials.

Up to four self-contained hydraulic feed drilling units can be employed, adjustably mounted on cross rail, to drill in excess of 50 hits per minute per spindle.

Write for detailed information and proposal — or ask to have an experienced sales engineer call.

SPECIFICATIONS*

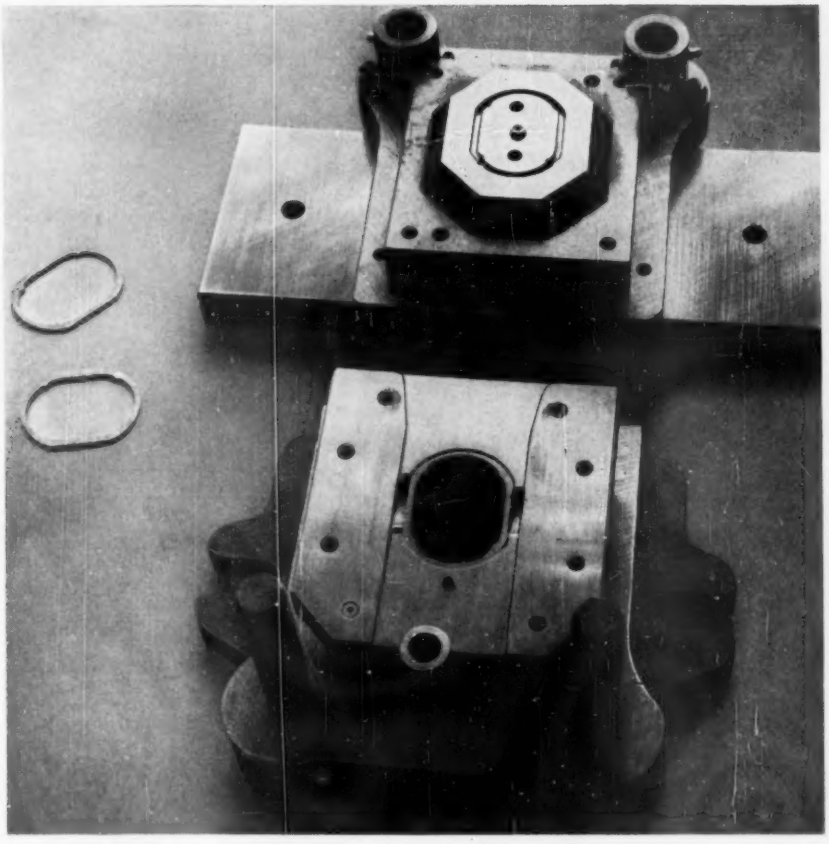
Positioning accuracy	±.001″ non-accumulative
Repeatability	±.0005″
Table size	to suit requirements
Table travel	Standard 11″ x 15″ Optional 19″ x 15″
Overhang	14″, Optional up to 22″
Spindle nose to table	Maximum 10″ Minimum 0
Available stroke	up to 4⅜″
Feed rate	infinitely adjustable
Geared spindle speeds	500 Minimum to 7500 Maximum or 1000 Minimum to 15,000 Maximum
Floor space required	Machine 60″ x 50″ Control cabinet 94″ x 47″

**Subject to change. Dimensions are approximate.*

LELAND-GIFFORD
WORCESTER 1, MASSACHUSETTS

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Blanking die output up 300 per cent when they changed to Bearcat tool steel

Bearcat is the major grade of tool steel in this compound die which blanks and pierces an automotive piston strut at Art Stamping, Inc., Cincinnati. The die, hardened to Rockwell C57-59, was fed slugs of .075-gage C1035 hot-rolled steel. With the tool steel formerly used, an average of 115,000 pieces was produced. But with the change to Bearcat, more than 500,000 pieces were obtained before die failure. That's really cutting costs!

Bearcat is our super grade of shock-resistant tool steel. And it has plenty of wear-resistance for long runs. An air-hardening grade, it minimizes quenching hazards and distortion in heat-treatment.

Bearcat is ideal for blanking and forming dies, hot headers, shear blades, punches, and die-casting die inserts. In fact, it's right at home in any application calling for unusual toughness.

If you would like to put Bearcat to work in your shop, get in touch with your Bethlehem tool steel distributor. He has Bearcat in stock, in a wide size range. Give him a call today.

Use Reader Service Card, CIRCLE 29

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Lehigh H Still the Best Non-Distorting Tool Steel

Many of today's new tool steel grades are air-hardening types, such as Bethlehem's Bearcat and Air-4. Tests on these new air-hardening grades invariably show relatively low distortion in heat-treatment. Measurements on small test pieces, or on specific tools, often show size changes, resulting from hardening, of about .0002-.0004 in. per in. But due to overenthusiasm, such results are often interpreted—and incorrectly—to indicate that the grades themselves are the long-sought "non-distorting tool steels."

However, tests on specimens of a variety of sizes and shapes show that individual dimension changes vary from zero to about .001 in. per in., averaging .0006-.0007 in. per in.

Production tools made from all medium alloy air-hardening tool steels will show low distortion to a degree which may eliminate many problems encountered with oil- or water-hardening tool steels.

When considering the low distortion of these steels, remember that Lehigh H (AISI D-2) has even lower distortion. Furthermore, the distortion resulting from heat-treatment of tools made of Lehigh H is both predictable and controllable, even to zero distortion, if required. This can be accomplished by the austenite-martensite balance method described in Bethlehem's tool steel catalog.

Such medium alloy air-hardening tool steels as Air-4, A-H5, and Bearcat are good performers on distortion. But Lehigh H is the best of all.

TYPICAL ANALYSES

	C	V	Mn	Cr	Mo	Pb
Air-4	0.95	—	2.00	2.20	1.10	0.25
A-H5	1.00	0.25	0.60	5.25	1.10	
Bearcat	0.50	—	0.70	3.25	1.40	
Lehigh H	1.55	0.90	—	11.50	0.80	

ANNOUNCING A NEW VANADIUM-ALLOYS DEPARTMENT FOR TOOL AND SPECIAL STEELS IN

cast to shape FORM

A brand new, completely equipped department for Cast-to-Shape tool and special steels—conventional sand casting or precision casting by the Shaw Process or shell molding—varied melting furnace capacity of 30 pounds, 300 pounds, 1000 pounds and 2000 pounds for flexibility in the casting of special analyses with maximum economy and service to our customers.

STANDARD GRADES	FORMEX—a 5% chrome hot work die steel. AIREX—a 5% chrome cold work, air hardening die steel. CROMEX—a 12% chrome cold work die steel.
SPECIAL COMPOSITIONS	Available to customer specifications.
TYPICAL APPLICATIONS	Forming rolls, cams, drop forge trimming dies, forming or blanking dies, molds, draw rings.

For sound castings of closely controlled chemical analysis, and to insure uniformity in machining and heat treating, come to VANADIUM-ALLOYS STEEL COMPANY.

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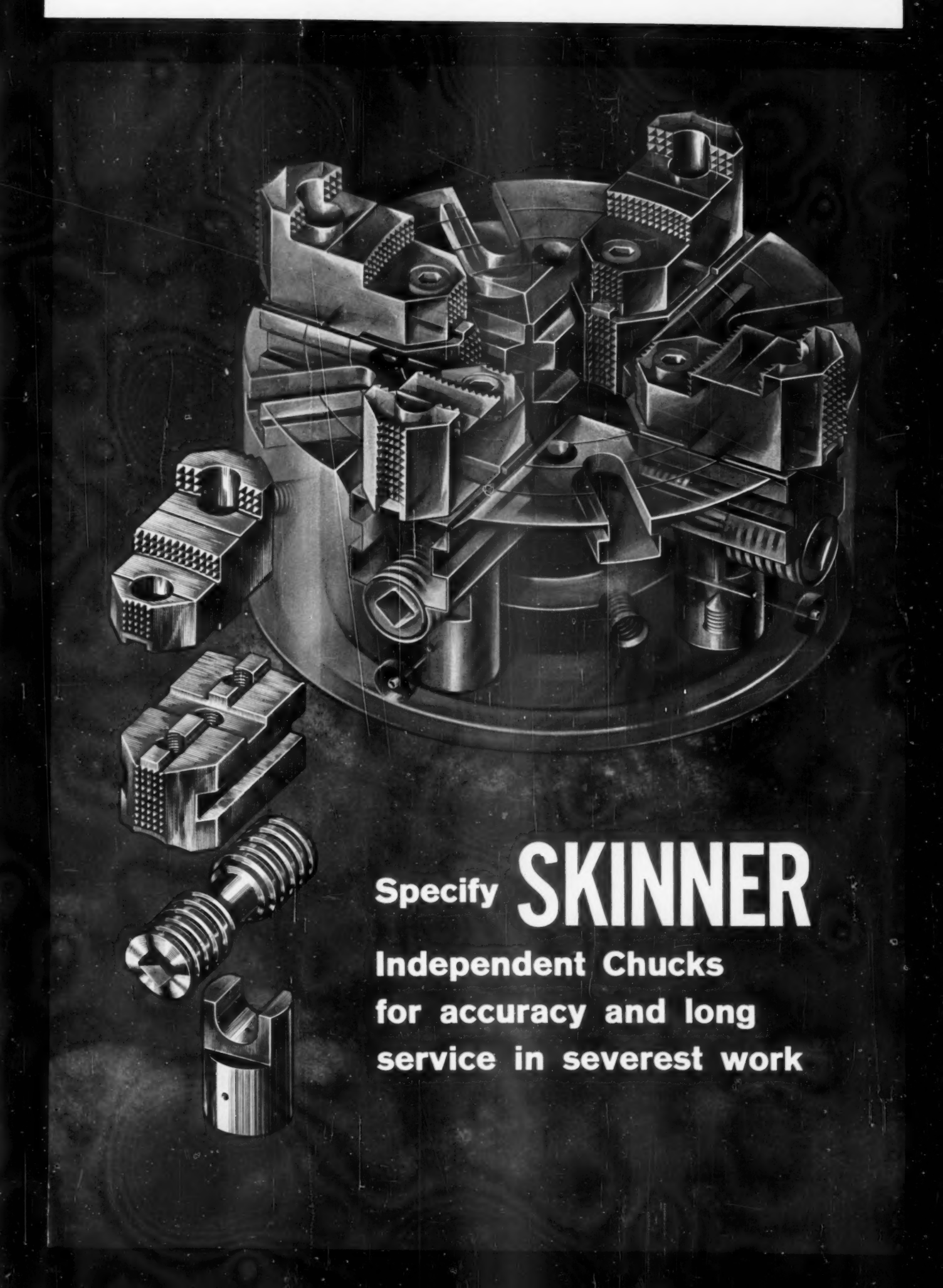
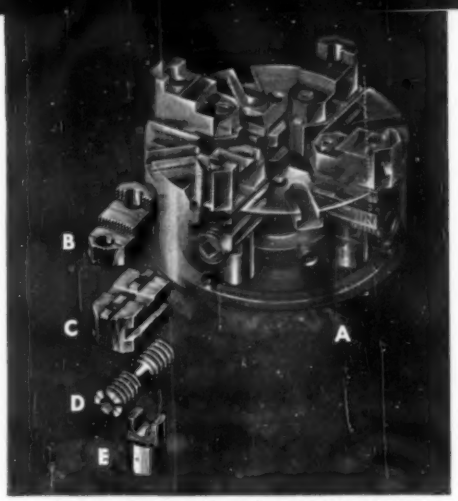

Specify SKINNER
Independent Chucks
for accuracy and long
service in severest work

FORGED STEEL BODY withstands extreme jaw pressures developed on modern production lathes.

Large Diameter Operating Screws permit long range of jaw adjustment and assure precision control of jaw movement.

Hardened Steel Solid Thrust Bearings absorb end thrust on flat parallel faces and are rigidly fitted to the chuck body.

Accurately Ground, Hardened Jaws available in two-piece construction shown here, master jaw with reversible hard stepped top jaw—or one-piece solid hard stepped reversible jaw.



A—Transparent view of heavy-duty independent chuck
B—Hard, stepped reversible top jaw C—Master jaw
D—Operating screw E—Solid thrust bearing

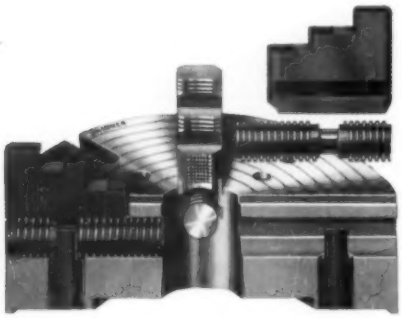
Superior Skinner design assures superior independent chuck performance

Skinner design achieves top chuck performance by combining separate parts of one chuck so that every part functions perfectly and in maximum support of other parts. See how the forged steel body surrounds more than 60% of the operating screw *for the full length of the screw*. Note the carefully machined jaw slots with heavy ribs to guide jaw movement and help hold jaw and screw in proper alignment at all times. See how the precision square threads of jaw and operating screw contribute further to even distribution of the strains set up by heavy gripping pressures. Every part is carefully made to exacting standards, and the whole chuck is *designed* to provide maximum gripping and accuracy.

Skinner heavy-duty independent chucks are designed for the rugged service required on modern turret lathes and have additional features such as:

- Wider jaws
- Larger and heavier operating screws
- T slots
- Specially designed bearings

An additional feature is the design of the master jaws below the face of the chuck, so that when top jaws are removed the chuck can be used as a face plate for clamping work.



Side view showing precise fit of operating screw, thrust bearing and jaw in medium duty chuck (solid jaws shown)

End view showing how chuck body surrounds 60% of screw circumference

General Information and Features	
Types and Sizes	Heavy-duty—12″ to 28″ Medium-duty—4″ to 36″ Light-duty—6″
Mounting	Skinner independent chucks are available for direct mounting on American Standard Spindles and for mounting on threaded spindle noses by means of separate adaptor plates.
Soft Blank Top Jaws	Standard height, extra high and long pointed sizes are available for heavy and medium duty chucks. Can be supplied or shaped to meet specific requirements.

Skinner manufactures a complete line of self-centering and combination scroll chucks, self-centering geared screw chucks, power chucks and accessories, packaged power chucking assemblies, and vises for milling, drilling and general machine work.

For complete details on Skinner Chucks and up-to-date information on major chuck developments, contact your Skinner representative or distributor, or write to us.

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THE CREST OF QUALITY

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SKINNER-HORTON CHUCK DIVISION
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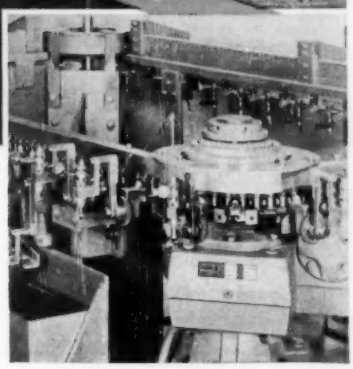

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You simplify the design job . . . select components needed from the BOSTON Gear Catalog . . . order all from one local source . . . and get products top-rated for performance and service life.

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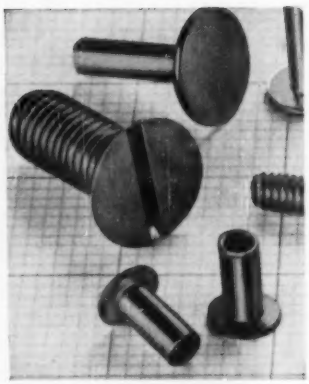
Your nearest Distributor LOOK UNDER "GEARS" in the "Yellow Pages"

— STANDARDIZATION PAYS —®

Cold heading is a high-speed, high-volume process even with intricate parts requiring secondary operations. Die sets are not expensive—set-up time is moderate. Scrap is no factor. Cold working improves mechanical properties. Use the handy chart and comparative data covering 14 suitable Anaconda alloys to open the door to some sizable savings. Take a second look at the way you're making parts like those at the right—and connector components in electrical controls—and bases for semiconductor devices.



Fast, low-cost cold heading with these Anaconda

Alloys and Nominal Compositions, %	Temper*	Prop. Limit, 1000 psi	Yield Str., 0.2% Offset, 1000 psi	Tensile Strength, 1000 psi	Red. Area, %	Plasticity Index, %
Brasses						
Commercial Bronze-14 90 Cu, 10 Zn	A B	20.5 39.0	43.0 57.5	51.0 64.0	85 81	40 61
Red Brass-24 85 Cu, 15 Zn	A B	23.0 42.0	49.5 62.0	55.0 71.0	82 77	42 59
Low Brass-32 80 Cu, 20 Zn	A B	33.5 44.0	50.0 65.0	57.0 76.5	81 79	59 58
Cartridge Brass-42 70 Cu, 30 Zn	A B	32.5 48.0	51.0 70.0	63.5 82.5	80 73	51 58
Yellow Brass-58 65 Cu, 35 Zn	A B	38.0 52.5	52.0 70.5	62.0 81.0	79 72	61 65
Cupro Nickels						
Cupro Nickel, 10%-755 88.35 Cu, 10 Ni, 1.25 Fe, 0.4 Mn	A B	38.5 56.5	52.0 76.5	54.0 79.0	81 80	71 72
Cupro Nickel, 20%-712 79.5 Cu, 20 Ni, 0.5 Mn	A B	34.5 46.0	57.5 69.5	60.5 74.0	83 74	57 62
Nickel Silvers						
Nickel Silver, 18%-716 72 Cu, 9.75 Zn, 18 Ni, 0.25 Mn	A B	37.5 39.5	57.5 64.5	60.0 67.5	83 78	62 59
Nickel Silver, 12%-744 65 Cu, 22.75 Zn, 12 Ni, 0.25 Mn	A B	43.0 50.5	58.0 81.0	67.0 86.0	77 73	64 59
Tin Bronzes						
Phosphor Bronze, (A)-351 94.75 Cu, 5 Sn, 0.25 P	A B	38.0 50.0	60.5 80.0	66.0 87.5	83 79	58 57
Phosphor Bronze, (C)-353 91.75 Cu, 8 Sn, 0.25 P	A B	44.0 57.0	64.0 90.0	76.5 99.0	81 76	58 58
Phosphor Bronze, (D)-354 89.75 Cu, 10 Sn, 0.25 P	A B	49.5 66.5	73.5 101.0	86.0 111.0	71 69	58 60
Leaded Copper-126 99 Cu, 1 Pb	A B	20.0 27.5	40.0 48.0	41.5 51.5	69 64	48 53
Copper-Silicon Alloy Everdur®-1015 98.25 Cu, 1.5 Si, 0.25 Mn	A B	34.5 43.5	54.0 67.0	55.5 74.0	81 76	62 59

*The temper designations "A" and "B" have no commercial significance.

This table includes results of special tension tests made in Anaconda laboratories. It is a useful guide to the right copper alloy for a cold heading job.

Each alloy is shown in two standard tempers, A (¼ hard) and B (½ hard). These designations show the amount of mechanical strengthening the alloy has been subjected to before cold heading. Though it is assumed that the cold heading process enhances these values, the preheading values are widely used in design—to be on the conservative side. The tempers obtained by wire drawing represent the following cold reductions: A, about 20%; B, just under 40%.

"Plasticity Index" is a useful indicator of the amount of cold work an alloy will take. It is the ratio of proportional limit to ultimate tensile strength expressed in per cent. A low value of the index indicates that a large part of the total stress range to fracture is devoted to deforming the alloy plastically. Thus an alloy with a low value flows more easily during the cold heading, and parts made from it can be designed with greater complexity of shape. For best formability, a low plasticity index should be coupled with a high percentage reduction in area—to minimize shear fracture.

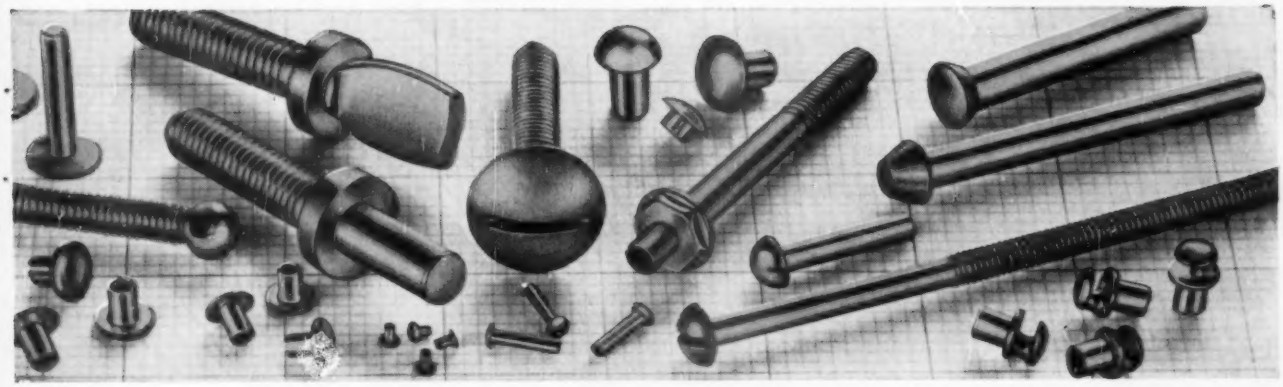
The effect of alloying elements on mechanical properties is clearly seen in the table. The main purpose of alloying copper is to increase ultimate and yield strengths. Alloying has other important effects, but the table shows how these alloying elements influence the balance between increased strength and formability in cold heading. In the selection of an alloy for cold heading, this interplay is usually the major consideration—with factors like corrosion resistance, color, surface finish, and cost playing supplementary roles.

WHAT ALLOYING ELEMENTS DO—Addition of a second element, or a series of elements, to copper affects the crystal structure so that flow in certain directions becomes difficult except by going to higher stress levels. The effect depends not only on the element added but on its proportion in the matrix. Here are brief descriptions of how the various major alloying elements influence the engineering behavior of copper metal:

ZINC plus copper makes brass up to 20%, the "low brasses"; from 20% to about 35%, the "high brasses." The addition of zinc substantially improves strength, yet the metal retains good formability (a low plasticity index with high reduction in area). Malleability does, however, decrease as the percentage of zinc increases. The diagram on the next page illustrates how a choice is made between alloys of similar zinc content. Thermal and electrical conductivity decrease as zinc content increases, and color changes from reddish hue to greenish yellow.

NICKEL, the principal alloying element in the cupro nickels, improves resistance to corrosion. In the nickel silvers, nickel and zinc also control color. As nickel content increases, color moves from brass shades to silver white. Both cupro nickels and nickel silvers have high percentage reduction in area. Their slightly higher plasticity index tends to reserve their use to parts requiring exceptional corrosion resistance.

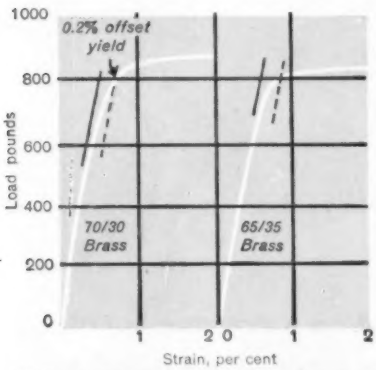
TIN as the main alloying element in the phosphor bronzes contributes high tensile and yield strengths, along with excellent fatigue resistance. For cold heading, the biggest advantage of phosphor bronzes is their favorable combination of low plasticity index and



alloys can solve more problems than you realize

high reduction in area—second only to the straight brasses. Electrical and thermal conductivities drop as tin content increases.

LEAD enhances the machinability of copper by acting as an embrittling agent, correspondingly reducing the per cent reduction in area, but with little effect on the plasticity index. For cold heading, this means that even though the plastic range is great, there is a limiting amount of work hardening that can be reconciled with shear strength. Though it is not recommended for shapes where shear forces predominate in the cold heading operation, Leaded Copper-126 has some very interesting advantages. It has an electrical conductivity rating of 98% IACS and a machinability rating of 80 (free-cutting brass = 100) for economical secondary operations. It offers a possible means of reducing the cost of electrical connector components, where shape and tolerances are within the range of cold heading capabilities.



Which is more ductile—70/30 brass or 65/35 brass? These load-strain curves on the two alloys in temper A (¼ hard, 18% reduction) shows 70/30 cartridge brass is slightly more formable—because it begins to flow plastically sooner than the 65/35, yet continues to deform to a higher ultimate load. Thus the plasticity index is lower. This, combined with higher per cent reduction in area, makes 70/30 a better choice when shear is a major factor.

SILICON content of 1.5% adds toughness to copper and improves its ductility — providing a combination of plasticity index and reduction in area favorable to cold heading. Such an alloy is well-suited to impact applications, particularly where very low temperatures are met, as in cryogenic equipment. As the lower copper-silicon alloys work-harden less rapidly than those of higher silicon content, Everdur-1015 (shown in the table) was developed for cold headed parts, especially where secondary operations, like roll-forming of threads, are required.

UPSET RATIO IS IMPORTANT — The alloys and alloy groups shown in the table are all suitable for cold heading. Often, however, the precise strength level or the exact service conditions are not known. Then the best guide is the approximate amount of cold work needed to form a given upset. This is the upset ratio—the ratio of final upset diameter to the original wire diameter.

WHEN UPSET RATIO IS FROM 2 TO 3, only one or two blows are usually necessary, and the choice of material is not critical. Any alloy from the table, in any temper, will be suitable.

WHEN UPSET RATIO APPROACHES 4.5 TO 5, two or more blows are necessary, and selection of material becomes critical. Choice is usually made after trial heading of one or more possible combinations of alloy and temper.

FOR UPSET RATIO OVER 5, multiblow or progressive heading must be employed, and annealing between blows may be necessary. Here only alloys with the most favorable combination of plasticity index and per cent reduction in area should be considered.

SEMICONDUCTOR BASES. As quantities of these components soar, cold heading should be considered for economical production. Many of the copper alloys offer the high electrical and thermal conductivities needed. But severe heat cycling in manufacture rules out the cold heading alloys listed. The metal must be deoxidized or oxygen-free to resist hydrogen embrittlement. For secondary operations, it must also have good machinability. And where high torque is used to tighten the base to the heat sink, it must in addition have high strength. Various combinations of these properties are found in such alloys as DLP Copper-104, OFHC* Copper-120, Tellurium Copper-127, and Chromium Copper-999 — all available as cold heading wire.

TECHNICAL SERVICE. Although Anaconda American Brass does not produce cold headed parts, it does make cold heading wire in the wide variety of alloys and tempers required. Anaconda has specialists in this field to help you select the right material for your job. Simply give us a sample, sketch, or description of the part or parts—along with service conditions, quantities, properties required — for a recommendation. See your Anaconda representative, or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 6662

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ANACONDA®

COPPER AND COPPER ALLOY COLD HEADING WIRE

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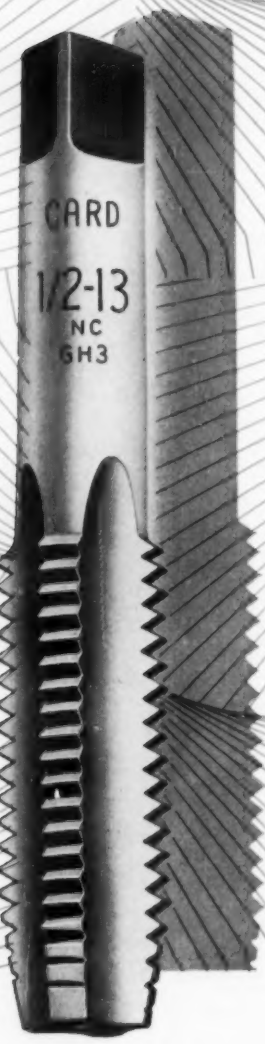

TAPS

DIES

GAGES

SCREW PLATES

PRECISE DUPLICATION can be visualized on a drawing board, by plotting geometric progressions. But to make this symbol a cutting tool reality calls for expert engineering. Engineering of this sort duplicates CARD tools precisely. CARD tools from best distributors, and valuable advice from CARD technical men are available coast to coast. S. W. CARD DIVISION, Union Twist Drill Company, Mansfield, Mass. CARD Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, and San Francisco.

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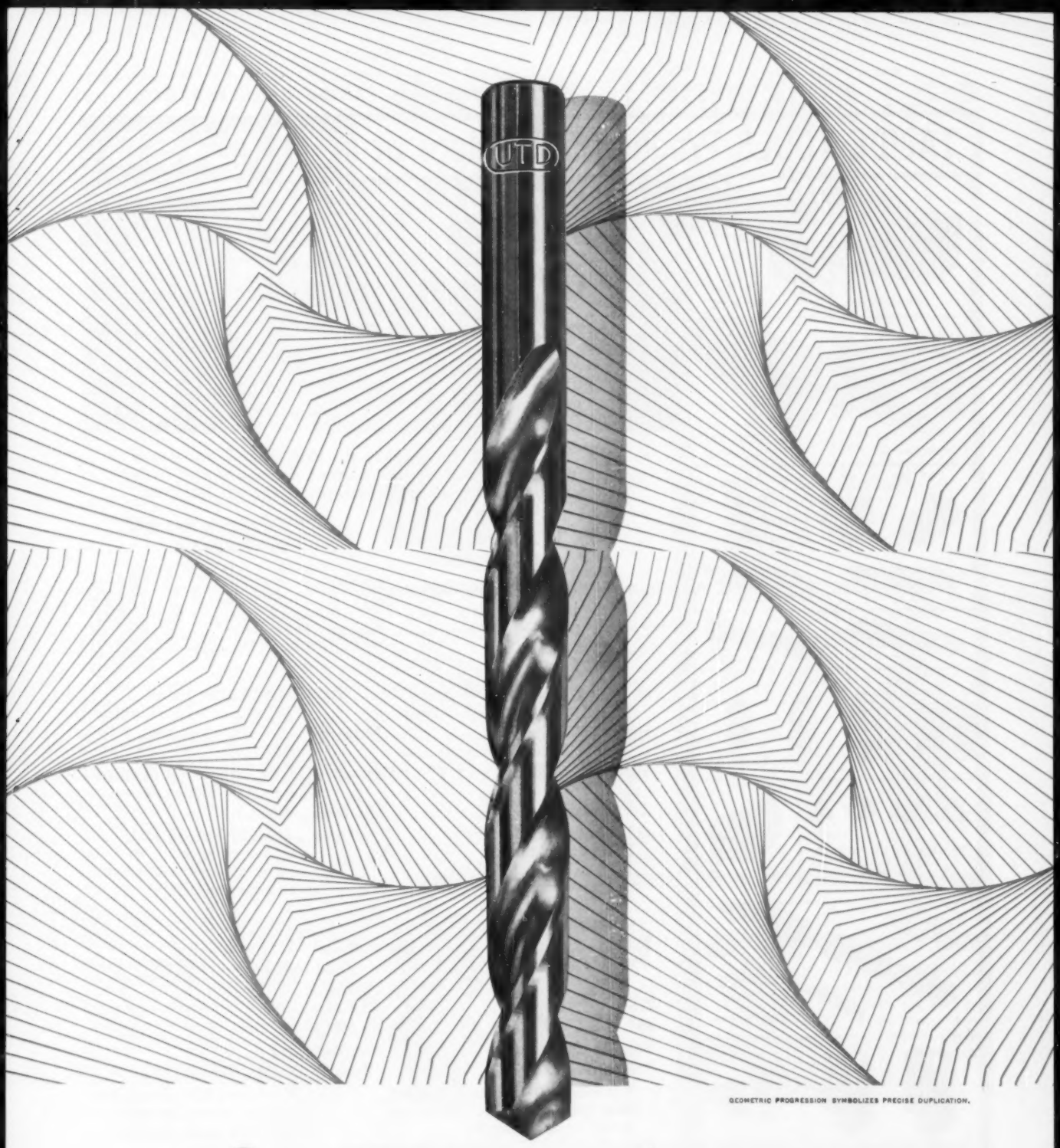

GEOMETRIC PROGRESSION SYMBOLIZES PRECISE DUPLICATION.

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MILLING CUTTERS
END MILLS
GEAR CUTTERS
HOBS
CARBIDE TOOLS
INSERTED BLADE CUTTERS

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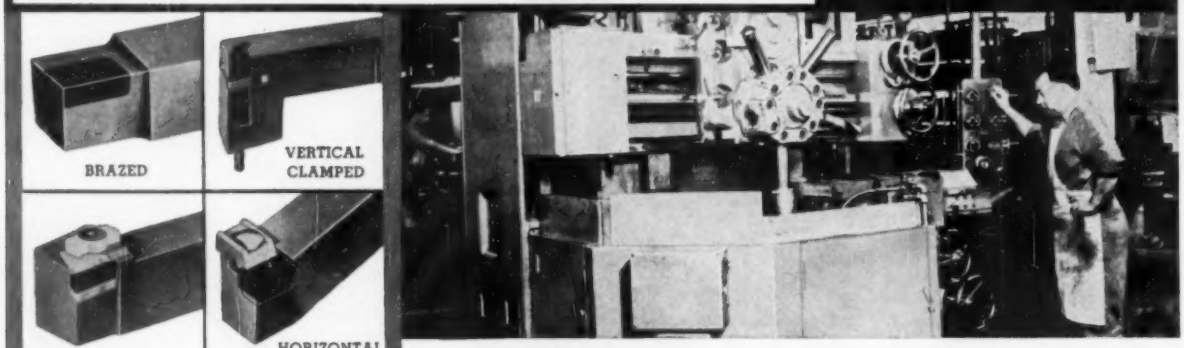
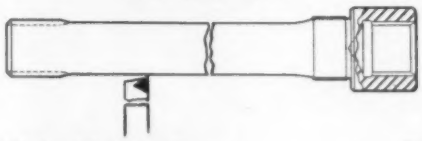
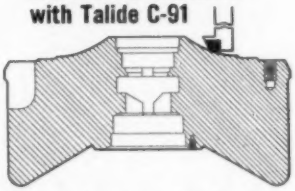


J.I.CASE® Co., Racine, Wisconsin, leading manufacturer of Agricultural and Industrial Equipment, reports Talide Tools give superior performance on **both** cast iron and steel jobs.

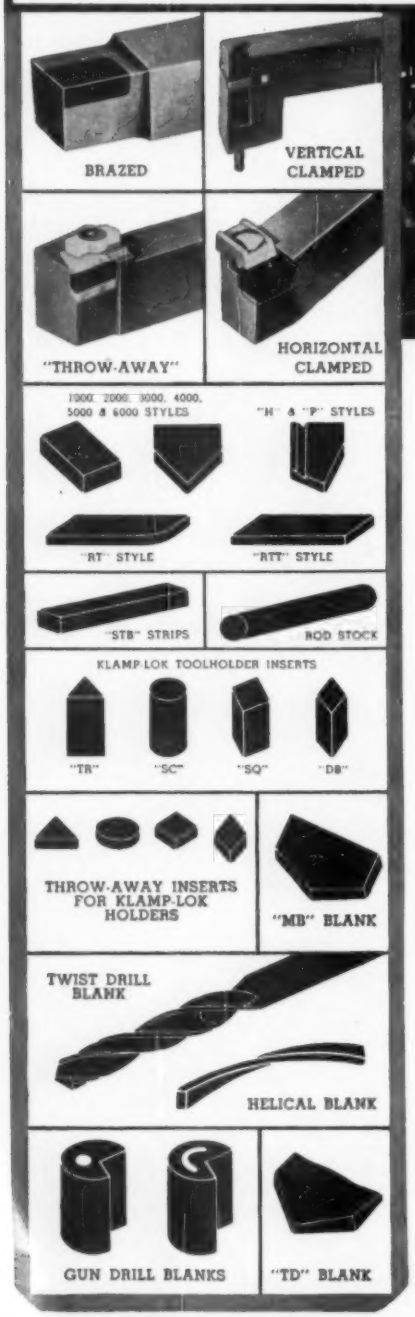
18 Shafts machined with Talide S-92



600 Wheels machined with Talide C-91



Main drive shaft 15/16" dia. x 16-15/32" long	**Part**	Rear tractor wheel 15" dia. x 7-19/32" thick
H.R. A-8640 steel 285-321 Brinell	**Material**	Hi-nickel cast iron SAE111
Turn O.D. of Shaft	**Operation**	Face outer edge of wheel hub, 1/2" wide cut
Carbo-matic	**Machine**	Bullard
#TN-163P3 Talide Disposable insert 1/2" I.C. x 3/16" thick, negative angle, 3/64" corner radii, Grade S-92	**Tools**	#GL-20 brazed tool, off-set style, 1-1/4" x 1-1/4" x 8" shank size, Grade C-91
1/16"	**Depth of Cut**	1/8" to 1/2"
.009	**Feed**	.033
115	**Speed (S.F.M.)**	210
450	**(R.P.M.)**	39
Soluble Oil	**Coolant**	dry
Talide Grade S-92	**Results**	Talide Grade C-91
Machined 18 shafts per grind. Next best premium grade produced only 12 shafts.		Machined 600 wheels per grind compared to 400 for next best premium grade.



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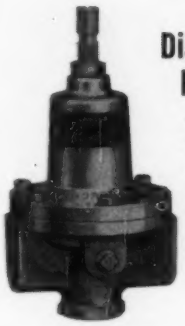
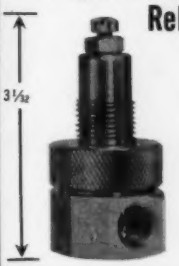
Norgren Diaphragm-Type Relief Valves and Flow-Control Valves



Diaphragm-Type Relief Valve

Type 62AX— for use with air, water, oil and similar fluids. ⅛", ¼", ⅜", ½", ¾", 1" pipe sizes. For relief pressures up to 250 psig (¼", ⅜", ½") and up to 125 psig (¾", 1").

Compact Diaphragm-Type Relief Valve

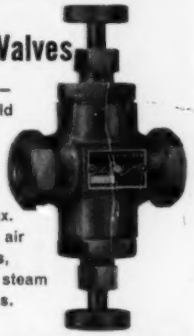


Type 40AB— for use with air, water, oil and similar fluids. ⅛", ¼" pipe sizes. Relief pressure adjustable up to 100 psig.

Pop Safety Valves

Type 1000— for air. ⅛", ¼", ⅜", ½" pipe sizes. Relief pressure ranges: 25 to 200 psig.

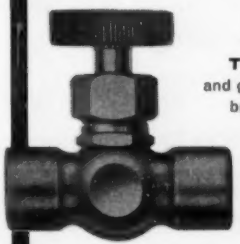
Flow Control Valves



Types 1100 and 1200— for air, oil, hot and cold water, steam, non-corrosive gases and liquids. Two-way and single-way valves. ¼", ⅜", ½" pipe sizes. Max. pressure: 250 psig on air and hydraulic systems, 125 psig on saturated steam and hot water systems.

Low Flow Relief Valves

Type 61A— for air, water and non-corrosive gases. ⅛", ¼" pipe sizes. For relief pressures: 25 to 300 psig.



Needle Valves

Type N— for air, liquids and gases that do not affect brass. ⅛", ¼" pipe sizes. Maximum pressure: 250 psig.

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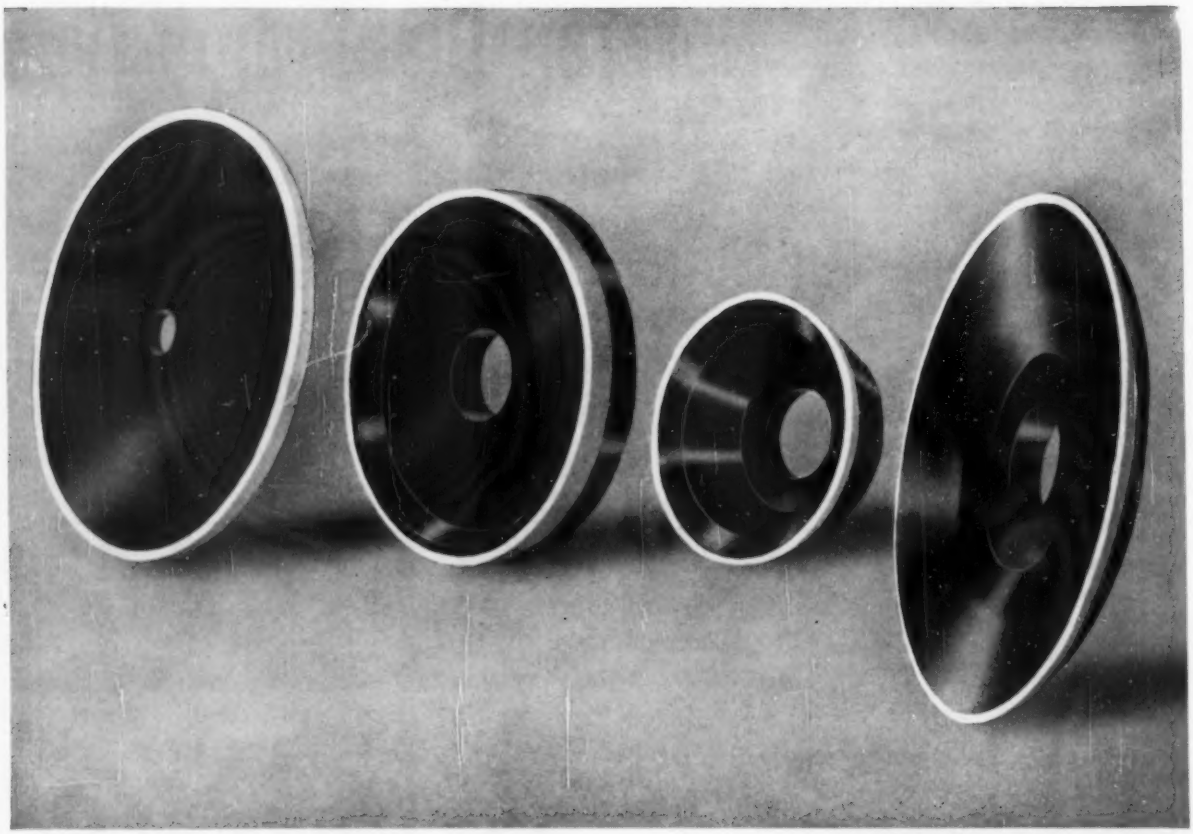

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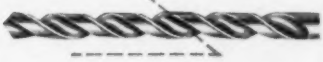
Regular Helix

This is the familiar style and the best helix for most general purpose shop work in steel, forgings, castings, and other ferrous materials. Where extra rigidity is required—as in portable drilling—select a regular helix drill with heavy duty construction.

Fast Helix



In general the fast helix is selected for drilling materials of low tensile strength like aluminum, magnesium, copper, and thermoplastics. These materials produce a large volume of chips and the low angle of incline of the flutes is specially suitable for their removal. Where chip removal is slowing drilling, the fast helix may solve the problem.

Slow Helix

This drill is generally used for materials that break up into very small or powdery chips . . . as occurs in drilling brass; hard rubber; thermo-setting plastics such as bakelite; fibre and plastic laminates. These drills are of light construction with wide flutes and are not usually suitable for heavy duty work.

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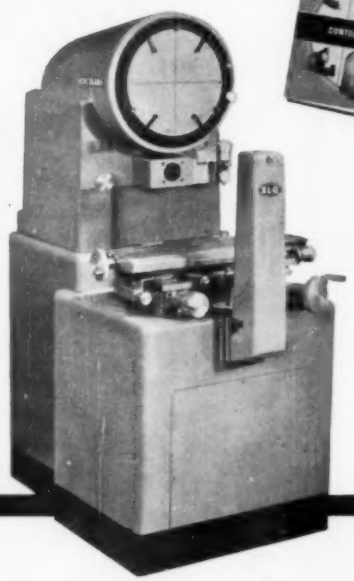

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Stentor	6" dia.	3.8 min.
1117	3⅛" dia.	27 sec.
1020	6" dia.	1.2 min.
4340	11¾" dia.	8 min.
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Machines illustrated can be arranged for both drilling and tapping. The M-15 Units are positive in operation as feed is geared directly to spindle drive gear.
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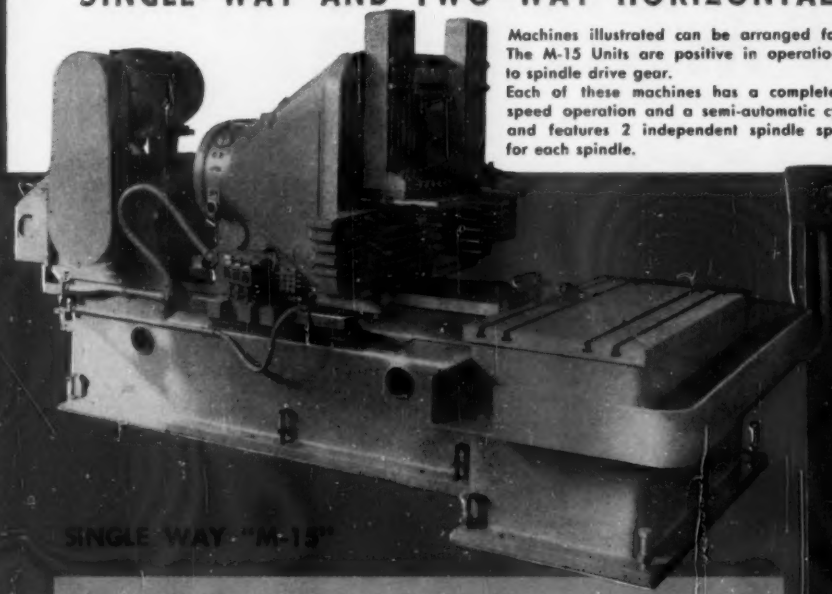

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The "M-15" Units used on both these machines are extremely versatile — positive in action — trouble free — fast operating and can be mounted vertically, horizontally, or at any angle needed for specific machine designs. These Units are also available in 10 H.P. to 40 H.P. capacity to meet requirements.
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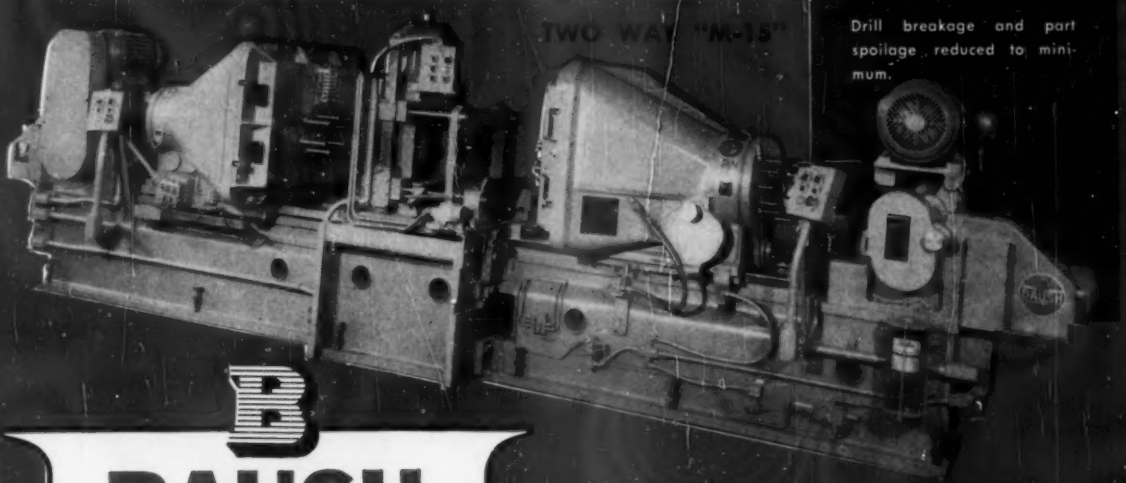

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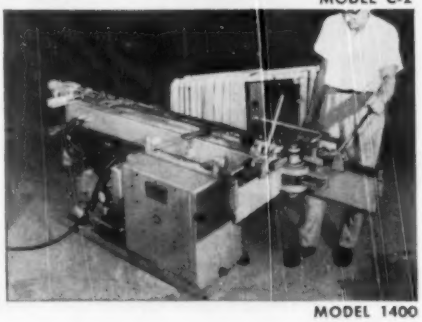
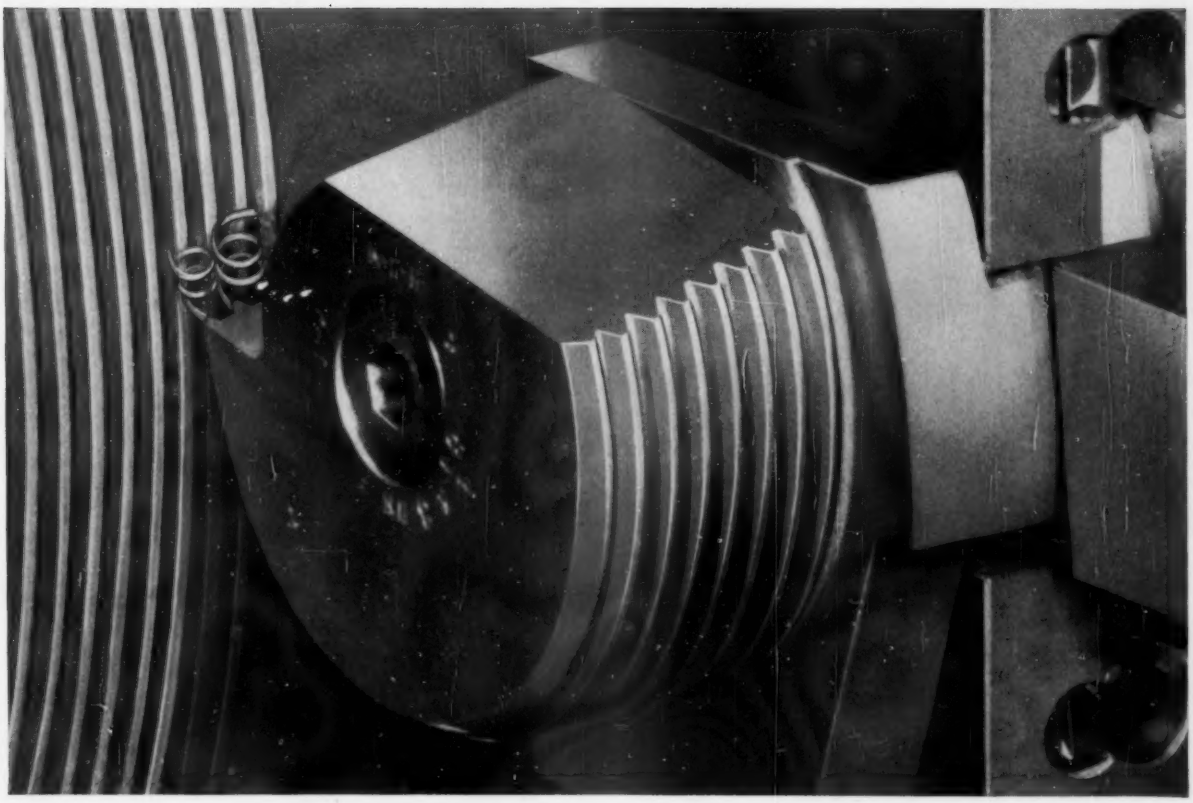


MODEL 1400



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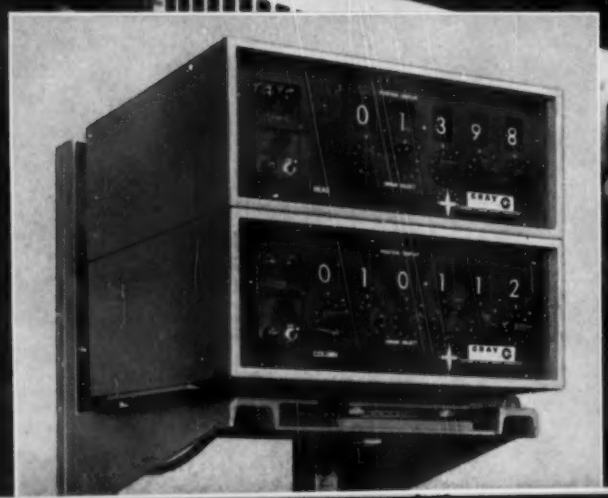
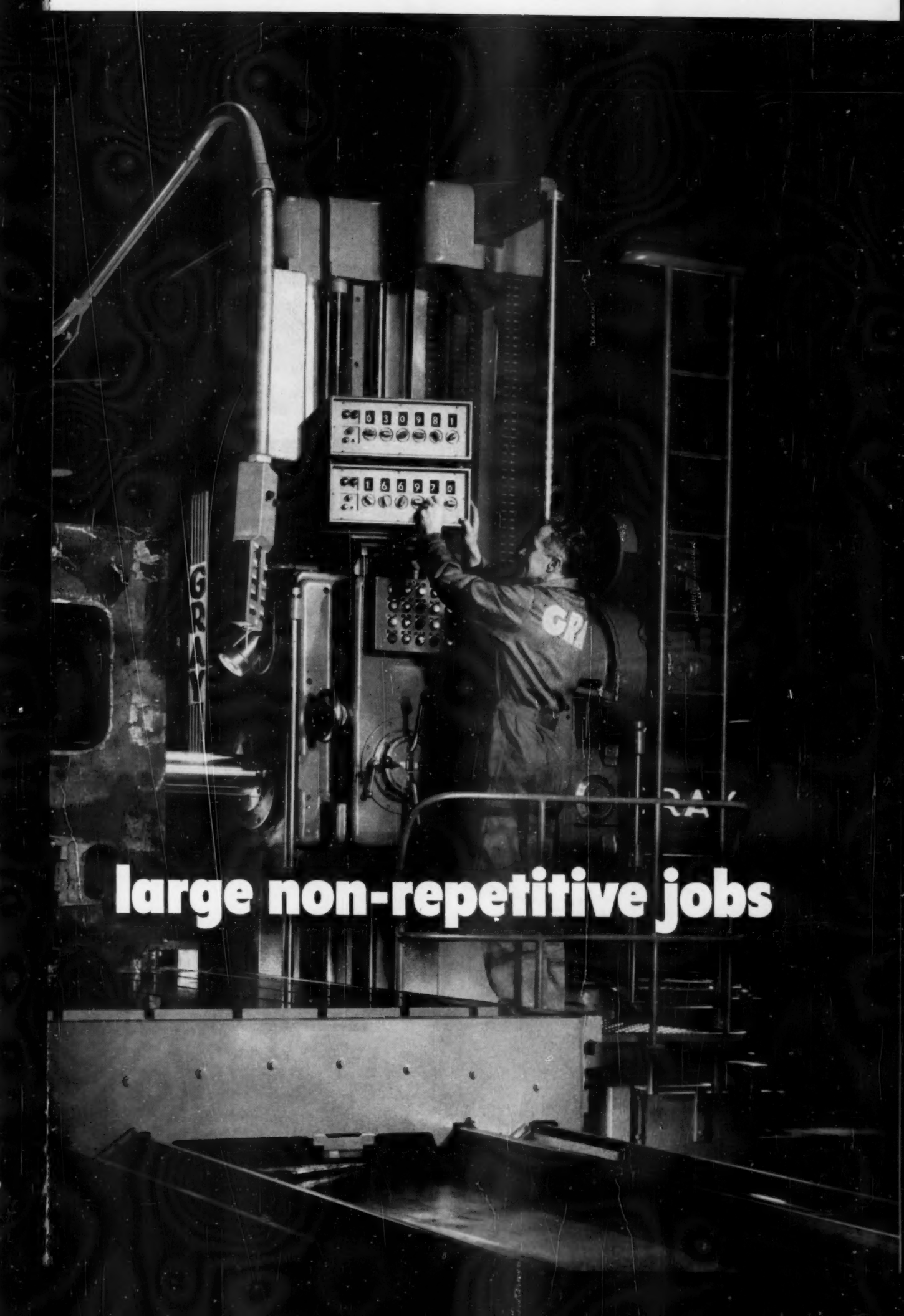
the perfect combination for




large non-repetitive jobs

TWO TOOLS

designed especially to meet the needs arising in small parts assembly and inspection

Here are two tools designed especially for small parts handling. Each meets different requirements. One may solve a major problem in your operations. See which will help you do a better job.

ILLUMINATED RIM-LITE MAGNIFIER

Equipped with a 5-inch precision-ground, distortion-free optical glass magnifier with a power of 3 diopters. Magnifier is mounted in circular, fully shielded lamp housing. Accepts standard C.F. (circular fluorescent) lamps, and delivers cool, shadowless, even illumination. Optional, auxiliary 2-diopter lens increases total power to 5 diopters by simply placing it onto standard lens.

Lens-light assembly may be raised or lowered on tubular upright, and locked at any desired position between 4" and 10" above the platform base. It can also be swung from side to side, or tilted. It can, in fact, be secured in any position suitable for assembly, soldering, welding and other similar operations.

Base is a solid-metal casting with accurately machined platform upon which parts or holding fixtures are placed. A felt pad is also supplied for jewelry or other delicate specimens.

NIKON SM2 STEREO MICROSCOPE

A rugged, precision-built instrument for 3-dimensional examination of small parts at magnifications ranging from 14 to 60 times. Image is erect and unreversed.

Use of high quality, hard-coated Nikkor optics and precise collimation permits continuous use without eyestrain. The SM2 has both coarse and fine focusing controls. The eyepieces are equipped with eyecups, and are inclined at an angle of 60° from the vertical. Inter-pupillary distance is adjustable from 55 to 75mm.

The basic SM2 consists of one pair of fixed objective lenses and one set of paired eyepieces for one magnification of your choice. Two additional sets of paired eyepieces, and two auxiliary objective attachments are available for eight additional magnifications. For complete details and list of accessories, write Dept. TE-1.

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fine pitch
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T-J
TOMKINS-JOHNSON TRIBUNE

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THE TOMKINS-JOHNSON CO. • 2425 W. Michigan Ave. • Jackson, Michigan

INCREASED PRODUCTION... CREATES PRICE ADJUSTMENT

on T-J Squair Head Cylinders

JACKSON, MICH. JAN. 3 (TP)—"Due to the tremendous initial response and the continuing acceptance and purchase of the new Tomkins-Johnson Squair Head Cylinders, it has been possible to *lower* the basic price," according to T-J personnel. In effecting this price cut, Tomkins-Johnson has again proven that acceptance of a quality product and the inevitable increase in manufacturing volume *CAN* economically justify a price reduction *WITHOUT* jeopardizing quality.

The T-J Squair Head Cylinder, an interchangeable air cylinder for any pneumatic power application, was first introduced by Tomkins-Johnson in 1958. It was an immediate success because of its availability in a wide range of bore sizes and strokes . . . as well as the standard quality features, including the new T-J Super-Cushion for air cylinders.

Other Standard Features

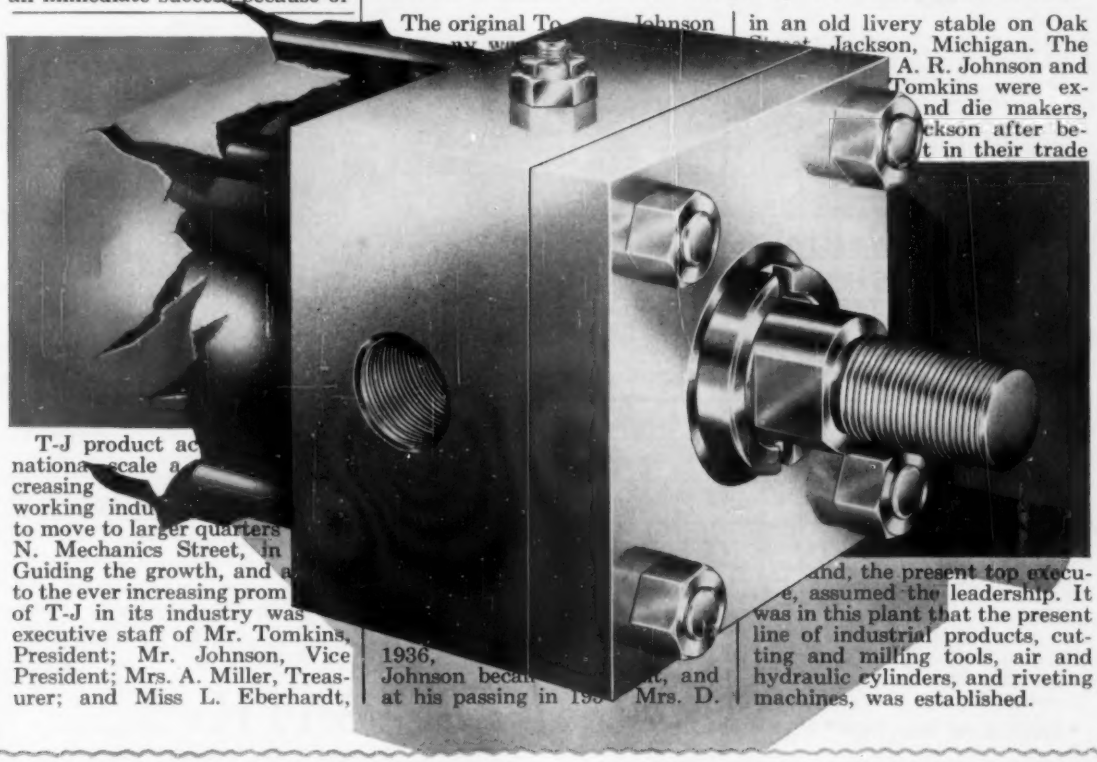
Other standard T-J features that allow the T-J Squair Head Cylinder to retain its high quality comparison over other makes of air cylinders and still give you lower price are; solid steel heads and mounting plates, hard-chrome plated bodies and piston rods, leak-proof cylinder head to body construction, heavy duty, high tensile ground and polished chrome, plated piston rod, and many more . . . STANDARD AT NO EXTRA COST.

Tomkins-Johnson, by virtue of the announced lower cost on its Squair Head Cylinder, wish to thank their customers for their initial acceptance which has been such a contributing factor in this price reduction.

T-J Produces Complete Line

Tomkins-Johnson also produces a complete line of hydraulic and pneumatic cylinders for *EVERY* power drive application . . . including the very popular Spacemaker. If you need further information or complete catalog material, write T-J direct, or request it from your T-J sales representative.

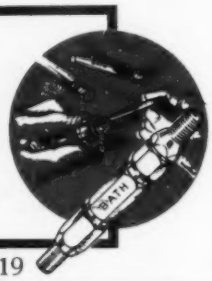
The Tomkins-Johnson Company was founded in 1917



The original To Johnson ... in an old livery stable on Oak ... Jackson, Michigan. The ... A. R. Johnson and ... Tomkins were ex- ... nd die makers, ... ckson after be- ... t in their trade ...

T-J product ac ... nationa scale a ... creasing ... working indu ... to move to larger quarters ... N. Mechanics Street, in ... Guiding the growth, and a ... to the ever increasing prom ... of T-J in its industry was ... executive staff of Mr. Tomkins, President; Mr. Johnson, Vice President; Mrs. A. Miller, Treasurer; and Miss L. Eberhardt, ... 1936, ... Johnson beca ... t, and at his passing in 19 ... Mrs. D. ... and, the present top execu- ... e, assumed the leadership. It was in this plant that the present line of industrial products, cutting and milling tools, air and hydraulic cylinders, and riveting machines, was established.

BATH *Tap'n Gage* TIMES



A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

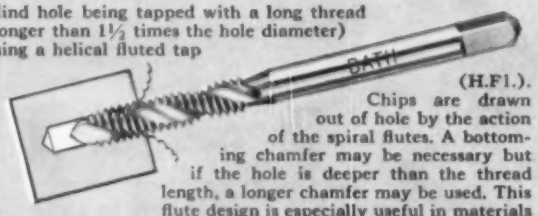
Vol. 1 No. 19

Subject: Flute Recommendations for Standard Taps:

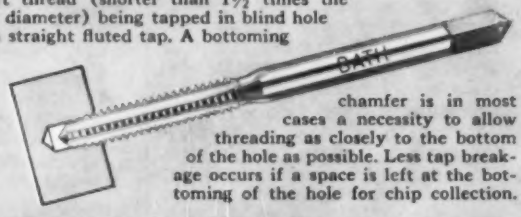
The number of flutes and flute design for taps are generally determined by the type of hole and the characteristics of the material in which the taps are to be used. The recommendations listed in the table below may be used as a guide but should not be considered conclusive because it may be necessary to weigh other factors to obtain the optimum flute design for each tapping application.

Open hole being threaded with spiral pointed (Sp. Pt.) tap. Chips are ejected through open end of hole by spiral point. Plug chamfers are usually applied to taps for threading this type of hole.

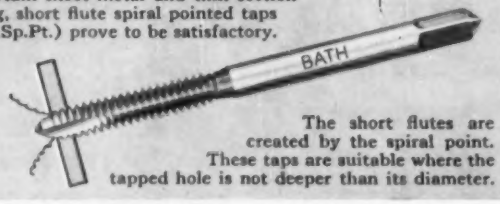
Blind hole being tapped with a long thread (longer than 1½ times the hole diameter) using a helical fluted tap (H.Fl.). Chips are drawn out of hole by the action of the spiral flutes. A bottoming chamfer may be necessary but if the hole is deeper than the thread length, a longer chamfer may be used. This flute design is especially useful in materials that produce long stringy chips.



Short thread (shorter than 1½ times the hole diameter) being tapped in blind hole with straight fluted tap. A bottoming chamfer is in most cases a necessity to allow threading as closely to the bottom of the hole as possible. Less tap breakage occurs if a space is left at the bottoming of the hole for chip collection.



For certain sheet metal and thin section tapping, short flute spiral pointed taps (Sh.Fl.Sp.Pt.) prove to be satisfactory. The short flutes are created by the spiral point. These taps are suitable where the tapped hole is not deeper than its diameter.



TAP SIZE	SOFT, DUCTILE MATERIALS SUCH AS SOME GRADES OF ALUMINUM, MAGNESIUM AND MILD STEEL ALLOYS				MEDIUM HARD MATERIALS SUCH AS COMMON CARBON STEELS AND SOME TYPES OF STAINLESS STEELS				BRITTLE OR ABRASIVE MATERIALS SUCH AS CAST IRON, CAST BRONZE, MEEHANITE SINTERED METALS AND PLASTICS				SHEET METAL AND THIN SECTIONS OF DUCTILE MATERIAL
	OPEN HOLES		BLIND HOLES		OPEN HOLES		BLIND HOLES		OPEN HOLES		BLIND HOLES		
	Short Thread	Long Thread	Short Thread	Long Thread	Short Thread	Long Thread	Short Thread	Long Thread	Short Thread	Long Thread	Short Thread	Long Thread	
#0 and #1	2 Sp. Pt.	2 Sp. Pt.	2	2	2	2 Sp. Pt.	2	2	2	2	2	2	
#2	2 Sp. Pt.	2 Sp. Pt.	2	2	3	2 Sp. Pt.	2	2	2	2	3	2	
#3	2 Sp. Pt.	2 Sp. Pt.	3	2 H. Fl.	3	2 Sp. Pt.	3	2	2	2	3	2	Sh. Fl. Sp. Pt.
#4	2 Sp. Pt.	2 Sp. Pt.	3	2 H. Fl.	3	2 Sp. Pt.	3	2 H. Fl.	2	2	3	2	Sh. Fl. Sp. Pt.
#5	2 Sp. Pt.	2 Sp. Pt.	3	2 H. Fl.	3	2 Sp. Pt.	3	2 H. Fl.	3	2	3	2	Sh. Fl. Sp. Pt.
#6	2 Sp. Pt.	2 Sp. Pt.	3	2 H. Fl.	3	2 Sp. Pt.	3	2 H. Fl.	3	3	3	2	Sh. Fl. Sp. Pt.
#8 thru #12	2 Sp. Pt.	2 Sp. Pt.	4	3 H. Fl.	4	2 Sp. Pt.	4	2 H. Fl.	4	4	4	4	Sh. Fl. Sp. Pt.
1/4"	2 Sp. Pt.	2 Sp. Pt.	4	3 H. Fl.	4	2 Sp. Pt.	4	3 H. Fl.	4	4	4	4	Sh. Fl. Sp. Pt.
5/16"	2 Sp. Pt.	2 Sp. Pt.	4	3 H. Fl.	4	2 Sp. Pt.	4	3 H. Fl.	4	4	4	4	Sh. Fl. Sp. Pt.
3/8"	3 Sp. Pt.	3 Sp. Pt.	4	3 H. Fl.	4	3 Sp. Pt.	4	3 H. Fl.	4	4	4	4	Sh. Fl. Sp. Pt.
7/16" & 1/2"	3 Sp. Pt.	3 Sp. Pt.	4	4 H. Fl.	4	3 Sp. Pt.	4	4 H. Fl.	4	4	4	4	Sh. Fl. Sp. Pt.
9/16" thru 1-1/8"	4	4	4	4	4	4	4	4	4	4	4	4	
1-1/4" - 7"	4	4	4	4	4	4	4	4	4	4	4	4	
1-1/4" - 12"	6	6	6	6	6	6	6	6	6	6	6	6	
1-3/8" - 6"	4	4	4	4	4	4	4	4	4	4	4	4	
1-3/8" - 12"	6	6	6	6	6	6	6	6	6	6	6	6	
1-1/2" - 6"	4	4	4	4	4	4	4	4	4	4	4	4	
1-1/2" - 12"	6	6	6	6	6	6	6	6	6	6	6	6	

Most common materials are tapped successfully with taps having flutes with regular hook, but some flutes having more hook than regular are more satisfactory for tapping soft, ductile materials. Hard, brittle materials sometimes require taps with flutes having less hook than regular.

To be assured of properly designed taps for your particular tapping requirements, specify the materials to be threaded to your Bath distributor . . . or to Bath engineers in Worcester, Mass.

• Cylindrical and Thread Gages • Ground Thread Taps • Internal Micrometers John BATH & Co., Inc.
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VERTICAL METROSCOPE

(BASED ON ABBE'S COMPARATOR PRINCIPLE)

Made in West Germany

A mechanical-optical measuring instrument in a form best suited to modern technical requirements. Measurements can be made on the external dimensions of parts with parallel surfaces, cylindrical parts, balls or pieces with spherical surfaces, and threads (pitch diameter by the 3-wire method).

Operator is seated, and his hands do not touch the instrument while measuring—thus it is not subjected to body heat which might affect precise measurements.

Raising or lowering of the measuring spindle and adjustment of reading devices is done by motor drives which are activated by levers on the right-hand side of the base. Spindle has a 4″ glass scale, the image of which is projected into a 1¾ x 3¼″ window at a magnification of 46x. Easy visibility permits fatigue-free measuring over long periods.

The instrument has a heavy cast base with column for the Abbe measuring unit. Measuring table is 6 11/16 x 5⅛″ and has two working surfaces. One side is grooved for general measuring while the other side has three ribs for gauge-block measurements. Auxiliary tables may be screwed onto the groove side for measuring balls, sheet metal, foil, turned parts with shoulders, etc., and for thread measurements.

Height of measuring unit is adjustable and while in its upper position affords a total working range of 8″.

Write for booklet

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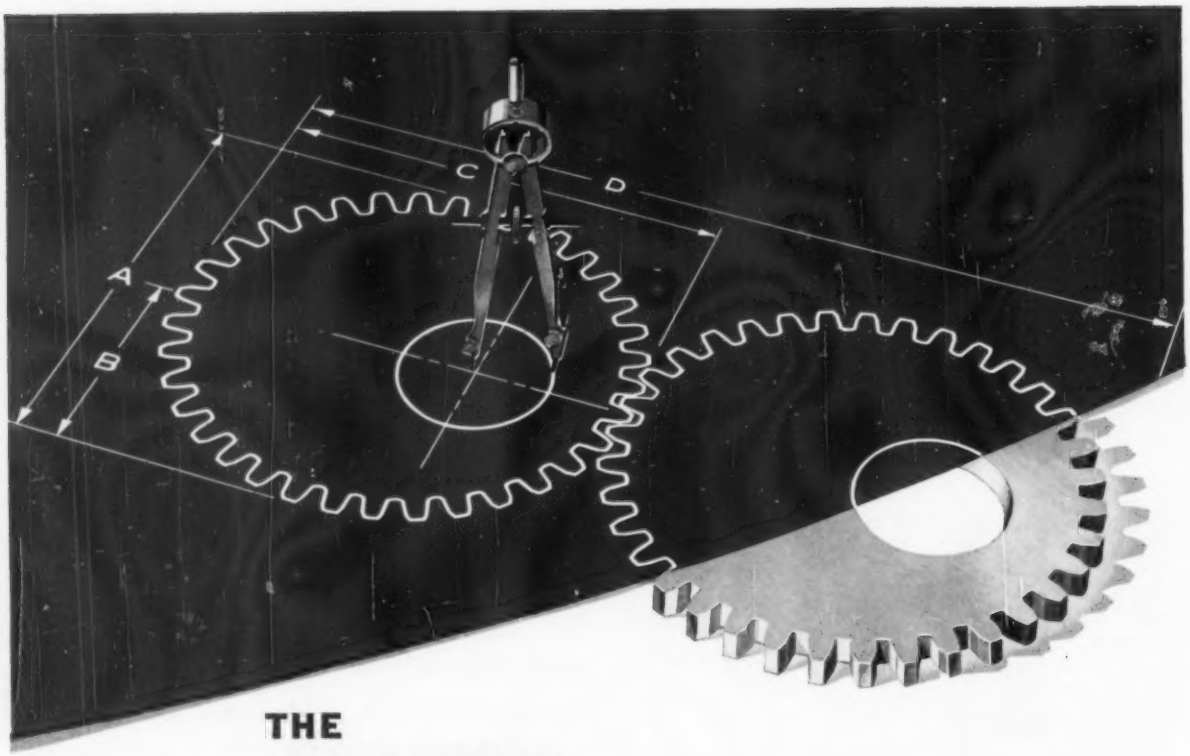

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. . . adds a new dimension to your design techniques

Designs that are right from a functional standpoint, often appear to be impractical from the standpoint of economical production.

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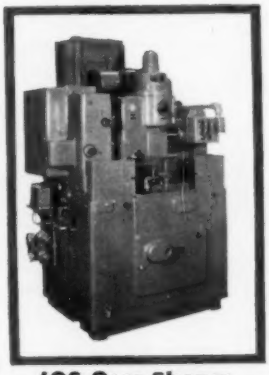

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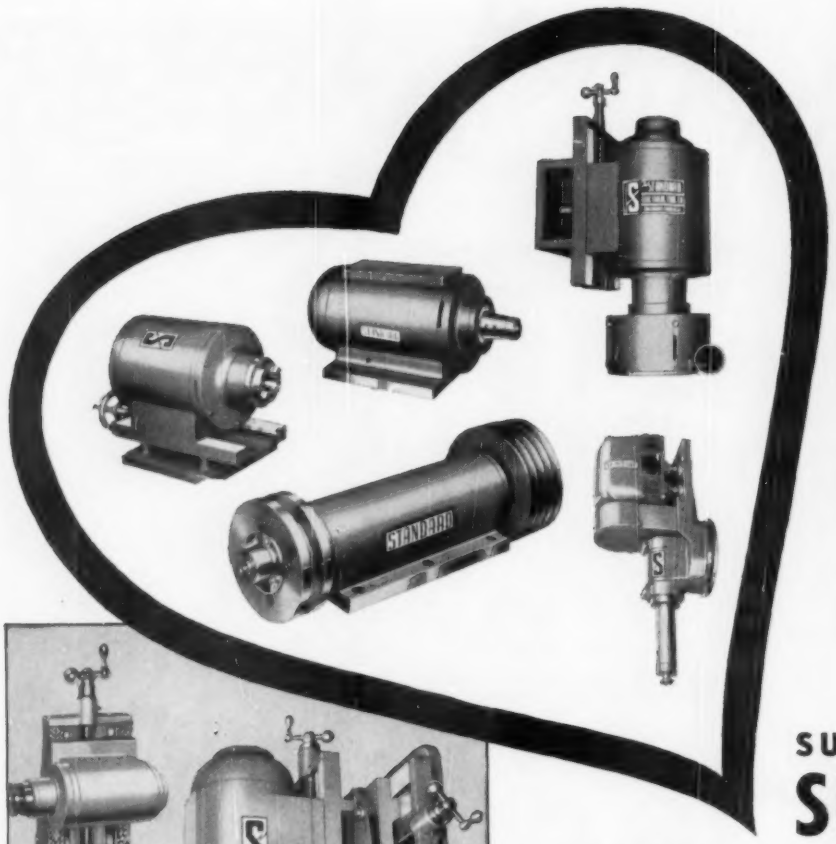

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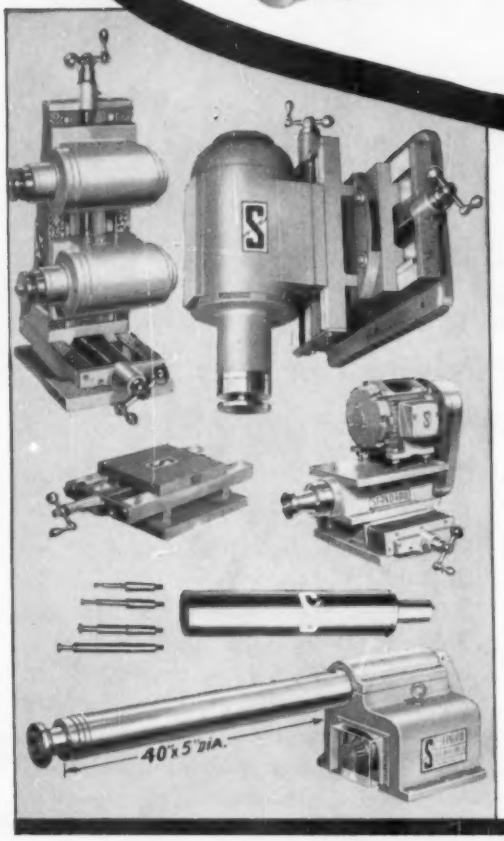

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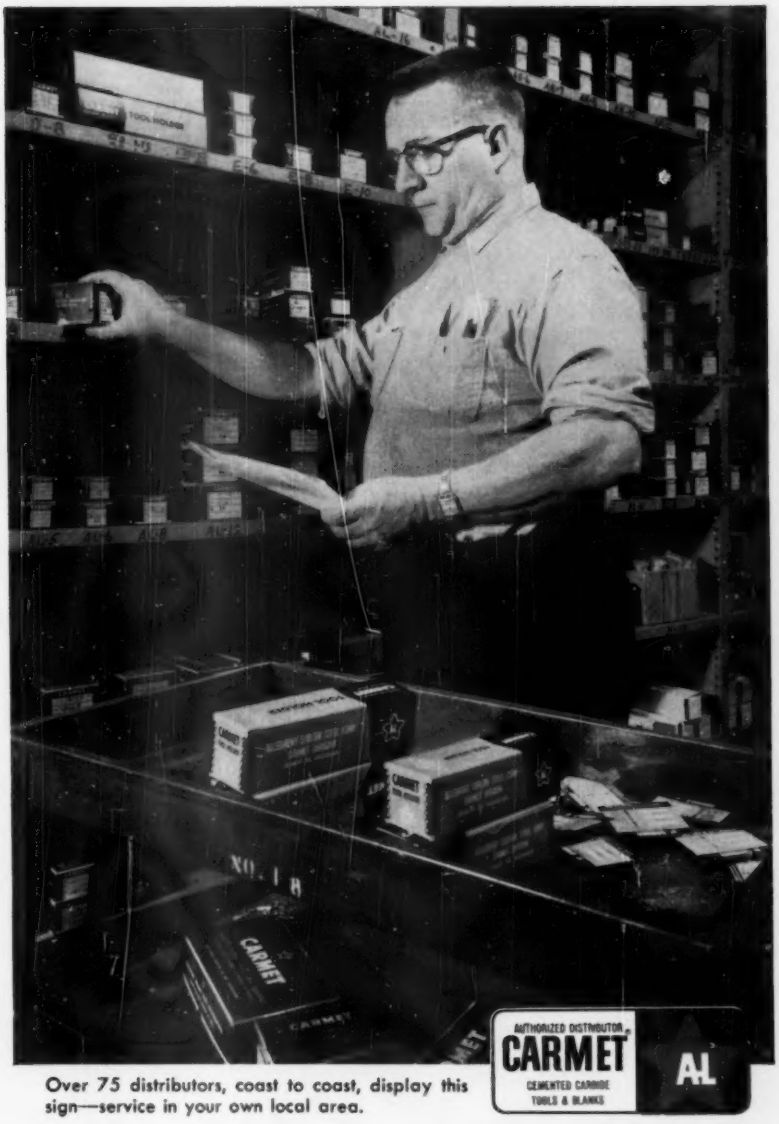

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"Brown & Sharpe puts this smooth blue finish on its Ready Mark® flat stock to solve three problems tool and die makers and heat treaters have had for years . . .

FIRST: *To prevent mistakes in the type of steel* picked up for a job. The blue color gives permanent identification, no matter how small the piece.

SECOND: *To protect the steel indefinitely from rust.*

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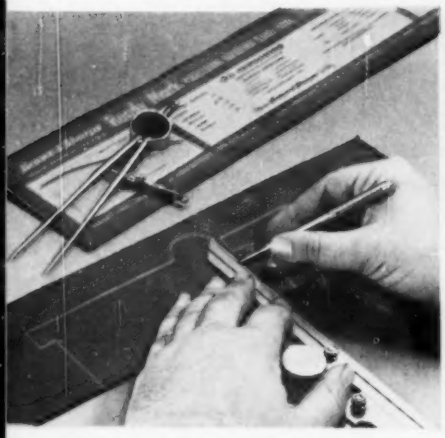
Sharpe's Ready Mark Flat Stock and saves layout time!"

Treating Dept., Brown & Sharpe Mfg. Co.



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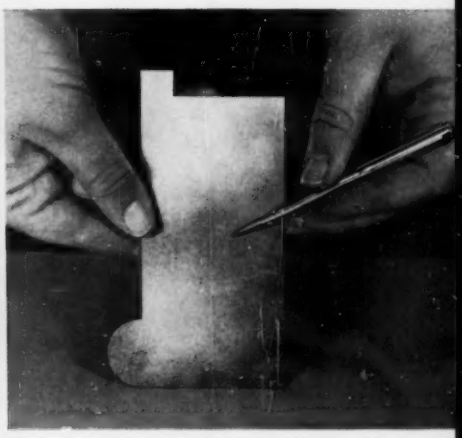
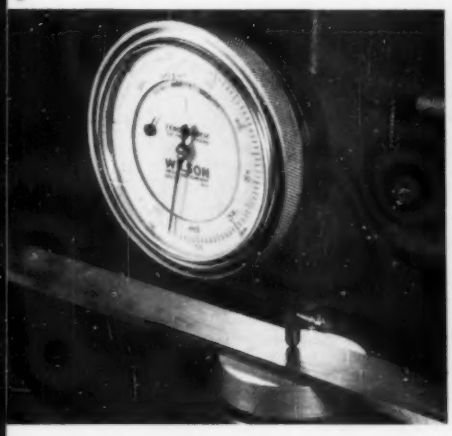
"Notice the color won't rub off or flake off the way marking fluids will. It won't even wash off in water, oils, coolants, or other agents used in shops. Your layout lines stay sharp and clear, through tough handling and machining.



"Color burns off during heat treatment, without affecting the treatment—leaves the piece at finish tolerances. This color deposit doesn't penetrate the steel or tend to etch the surface — so it doesn't have to be ground off later.



"Under the color, you get the country's best free-machining, non-deforming A.I.S.I. Type 01 Oil Hardening Tool Steel. Every lot is quality tested to be sure that it meets rigid Brown & Sharpe specifications.

"We grind it to precise sizes for you — every one free from decarb and machining stresses. They're colored . . . individually packaged . . . with complete description and heat treating instructions on each package.

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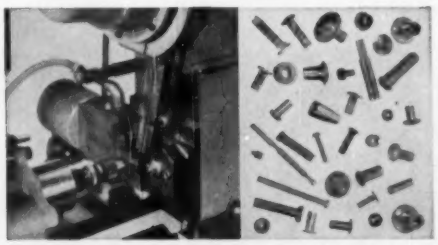

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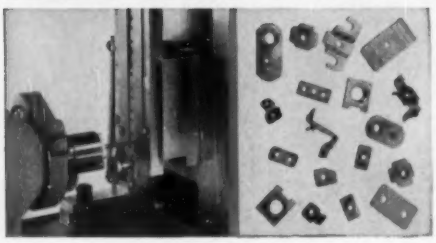

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This is the time of year when you probably have been thinking about the year ahead and making some New Year's Resolutions. Resolutions that in 1961 you are really going to do those things for your personal advancement that you couldn't crowd into your busy schedule in 1960.

Now is a good time to set up your personal plan for the future. A plan is like a road map—it will help you to reach your goal.

But first you will have to establish your personal goals. Most of us agree that our ultimate goal in life is Success. Maybe you'll define success as happiness that comes from your providing for those you love the security that comes from your effective performance on the job.

To attain this kind of success, you'll have to acquire greater manufacturing know-how and the ability to apply that know-how so that your company is successful.

Your Society can help you attain success. Recently, Society leaders concluded a series of Long-Range Planning meetings. The Society's Long-Range Plan is a simple one—to make available to you the latest scientific knowledge in the field of tool and manufacturing engineering, using every available means of disseminating this knowledge.

As a first step in your personal Success Plan, you owe it to yourself to take advantage of all of the opportunities the Society offers you. The know-how obtainable through reading THE TOOL AND MANUFACTURING ENGINEER, through attending chapter meetings, seminars, conferences, workshops, expositions and the like, and through working on Society committees, can be of inestimable value to you in putting your Success Plan into action. And, as a final step in your Success Plan, you'll have to put the know-how you gain through ASTME to work in your plant.

Acquiring know-how, putting it to work—these are your personal keys to Success. Plan to succeed—and put that plan into action now!

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SPS

where reliability replaces probability

direct energy CONVERS ON ...key to lower-cost manufacturing?

Will machine tools someday be run directly by solar energy? New energy conversion sources make this a possibility. Initial applications, however, will probably be restricted to trapping the heat energy that is now lost in most plant operations and converting it to electrical energy.

NEARLY EVERYTHING WE DO requires conversion of energy—it is involved in coin-operated slot machines, in walking, in driving a car. The coin's potential energy is converted to a mechanical movement. Walking uses the body's complex chemistry to exchange sugar for movement. Burning gas forces pistons to reciprocate and propel a car. Energy conversion systems are often long, involved, and inefficient—as when coal (originally produced by the sun) is burned to make heat that drives a turbine connected to a generator to produce electricity. Now a new type of energy conversion, using free radicals at room temperature, has been demonstrated in laboratory models, as shown in *Fig.* 1. This conversion system is direct.

Conversion Cycle: Energy input to the conversion system can be electric, thermal, or radiant, such as the sun's rays, alpha, beta and gamma rays. The input energy is used to disassociate molecular (diatomic) hydrogen and store it in free radical (monatomic) form in palladium or other materials. When the atoms leave the palladium, great amounts of energy are released as they recombine. As shown in *Fig.* 2, the system uses hydrogen in a continuous loop. Palladium, in its sponge-like ability to disassociatively absorb hydrogen, behaves similar to an ordinary storage battery. A sensitizing agent forces hydrogen out of the palladium and the atoms recombine at a catalytic surface to focus the energy for output. Recombined hydrogen is recirculated and reinserted into the palladium, thus making a complete energy-carrying loop of the hydrogen.

Output can be taken continuously or intermittently under control of the sensitizing agent. In the absence of a sensitizing agent, the palladium simply stores energy. With both hydrogen and sensitizing agent flowing past and through the palladium, a continuous output of energy can be sustained. This is analogous to charging a battery with a generator while the battery discharges cur-

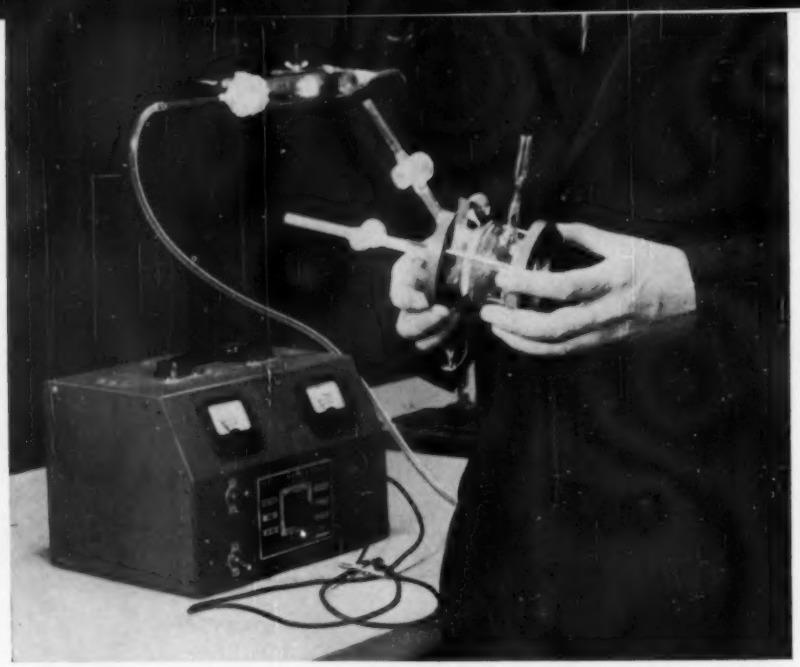


Fig. 1. An operating prototype of a free radical energy conversion system developed and made by Energy Conversion Laboratories.

rent to a load. The catalytic plate receiving energy from atomic recombination can give off the energy as heat, or if one side of the catalytic plate is coated with an emissive material, it can act as a cathode for thermionic generation of electricity.

Applications: The system can use diffuse low-level energy sources and focus them to a high enough level to drive some load, using either thermal or electric transmission of energy to the load. High-energy sources, such as gamma rays can serve as input. Palladium can store 1000 times its volume of atomic hydrogen whose potential energy (216,000 kilojoules per kilogram) is about 20 times greater than that of a conventional energy source, such as gas and air. Thus it can serve as an energy storage device. High-conversion efficiencies are expected because the device works at room temperature, without moving parts, using a high-potential energy transfer medium.

To date, diffuse environmental energy has been captured and used to drive a filament. The conversion system is being investigated as a portable power source, with the sun's rays as input and electric current as output. The advantages of such an application are that large thermal generating stations can be de-emphasized and the use of transmission lines minimized. The device is also receiving consideration as an energy conversion means for space vehicles—cosmic radiation can be utilized and focused by the system. Any waste heat is a potential input to the conversion system. For example, the heat of an automobile exhaust could drive a system to produce electricity directly, eliminating the power losses associated with an automobile generator. Development of this and similar devices will enable plant engineers to regard an entire plant as an energy input-output system. Waste heat, instead of being dissipated into an environment can be recaptured and used. For instance, heat from machining operations could be transferred into a conversion system and returned to help run the machine electrically. This would serve a dual function of cooling the work and increasing the efficiency of energy utilization. Practical applications are probably many years in the future but the potential savings possible through direct energy conversion make further research worthwhile.

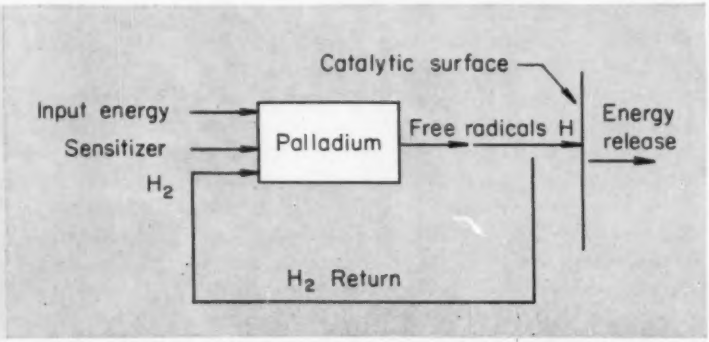


Fig. 2. Hydrogen is used in a continuous loop as the energy transfer medium.

Gadgets

Ingenious Devices And Ideas

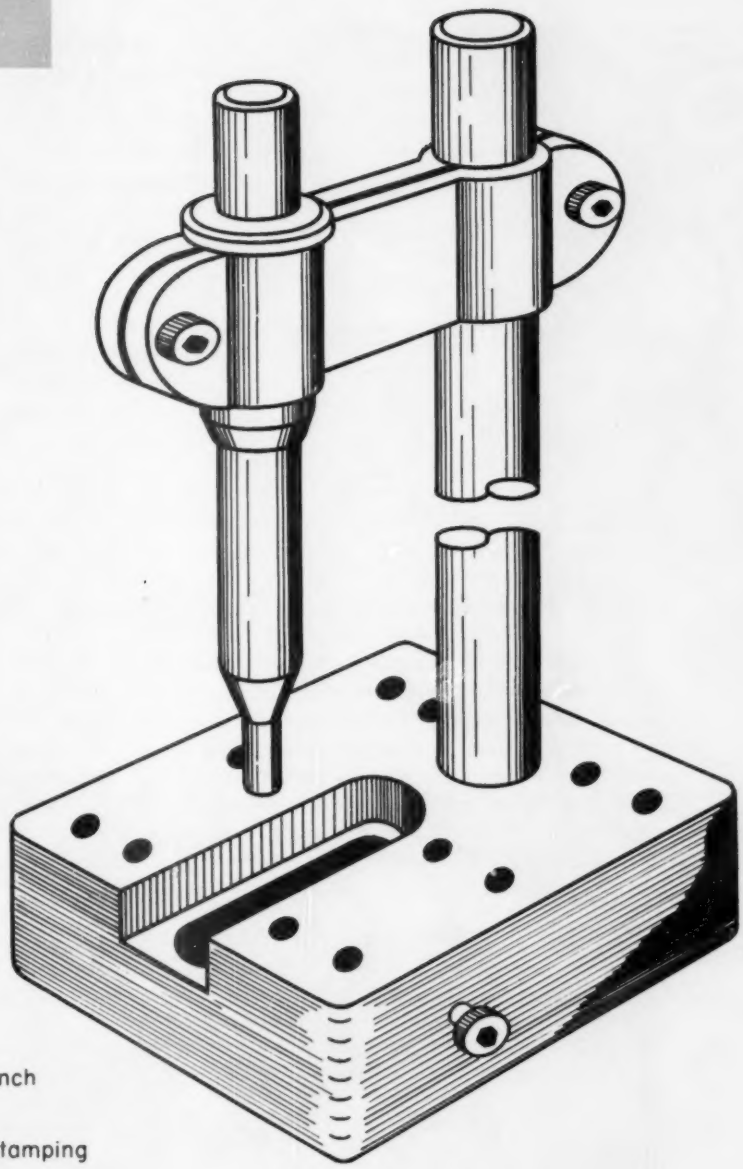
Hole-Piercing Fixture for Short-Run Production

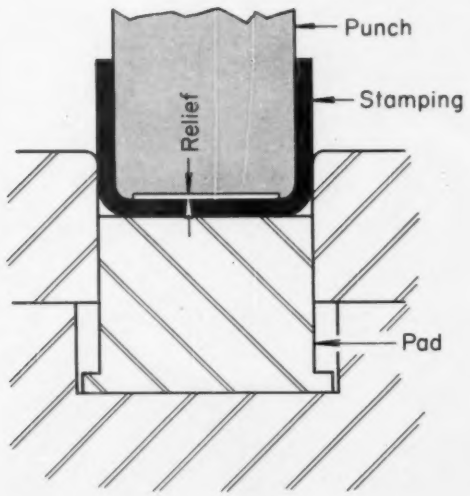
Designed and built for experimental work, this fixture can be used to pierce a wide variety of hole sizes. Piercing can be performed either manually or by a setup in a press.

To eliminate the need for special bushings, all punches should have the same body size. Mating hole locations in the die shoes are relatively unimportant, since the head can be adjusted radially to provide correct alignment.

When comparatively heavy metal is pierced, stripping devices are useful. These can take the form of leaf type strippers screwed to any of the tapped holes in the base. These holes are also useful for gage attachments in light-production runs. If piercing is performed manually, headed punches with spring returns should be utilized as an aid to stripping.

Henry E. Piltz
East Orange, N. J.

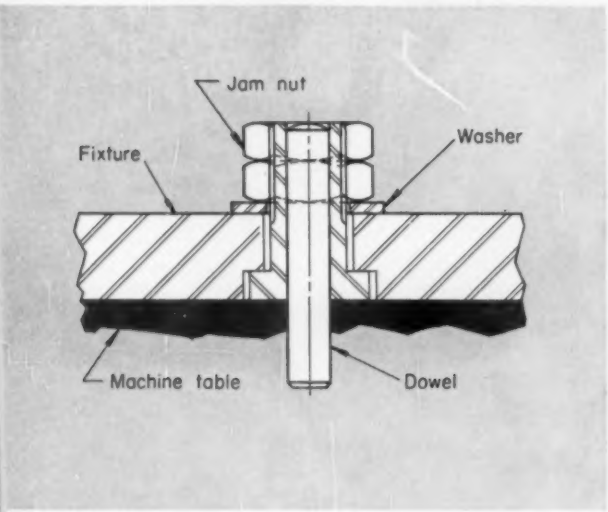




Relieved Punch Sets Die Radius

Female radii in forming operations are expensive to machine and contribute little to die performance except in setting the metal. One method of eliminating female radii in this function is to relieve the punch as shown. This relief—approximately 0.005 inch deep—permits the part radius to take the full pressure of the press stroke, effectively setting it at a prescribed dimension.

Cliff Bossmann, Dayton, Ohio



Adjustable Dowel Pin for Quick Fixture Location

Jig boring is often used to correctly locate holes in precision fixtures that must be doweled to machine tables. Another method is to use the adjustable dowel pin illustrated. This device requires counterbored clearance holes into which dowel pin retainers are fitted. The clearance holes around the retainer permit easy adjustment of the fixture at any preselected position.

After the fixture has been indicated to correct alignment, the jam nuts are tightened. This effectively maintains fixture alignment throughout machining.

The adjustable dowel pin eliminates the need for time-consuming jig boring and, at the same time insures absolute accuracy in fixture positioning.

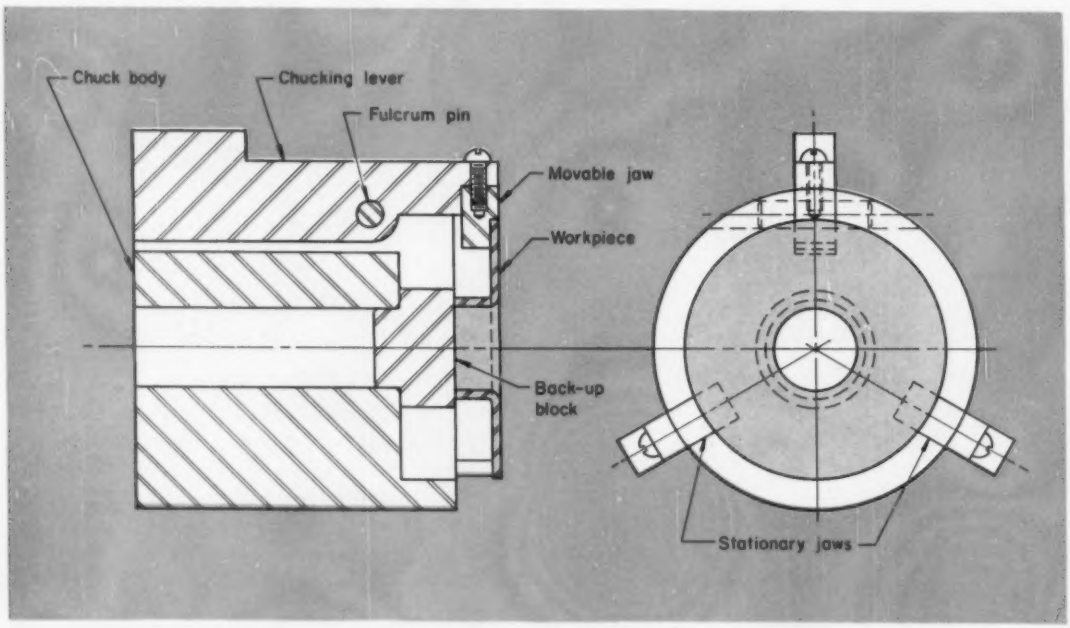
Robert D. James
Rock Island, Ill.

Chuck Jaws Are Activated by Centrifugal Force

Designed to hold stampings during polishing and deburring operations, this chuck utilizes centrifugal force to activate a tightening jaw against two stationary jaws. Its principal advantage is the speed with which parts can be loaded and discharged. When the chuck is idle its movable jaw is open to receive the workpiece. At the start of spindle rotation, a chucking bar pivoting on a fulcrum pin moves out causing the jaw to tighten on the part.

Holding power—a critical factor in this device—is directly proportional to the speed of rotation. Slow speeds provide insufficient holding power and abnormally high speeds build up excessive pressure on the workpiece. For optimum results in machining light parts, the chuck should be operated at speeds between 3500 and 5000 rpm.

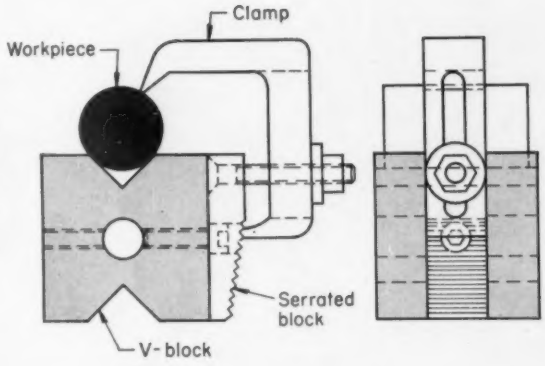
E. Millholland
Indianapolis Chapter



V-Block Makes Through-Machining Possible

Elimination of clamp interference makes grinding and machining possible throughout the entire length of a part in this V-block. Fixturing is effected by an off-center clamp which bears on the workpiece and on an angular serrated block. These serrations, machined in a tapered surface, enable the clamping surface to remain parallel to the V-block irrespective of workpiece size.

C. Gibbons
Kingston, N. S.

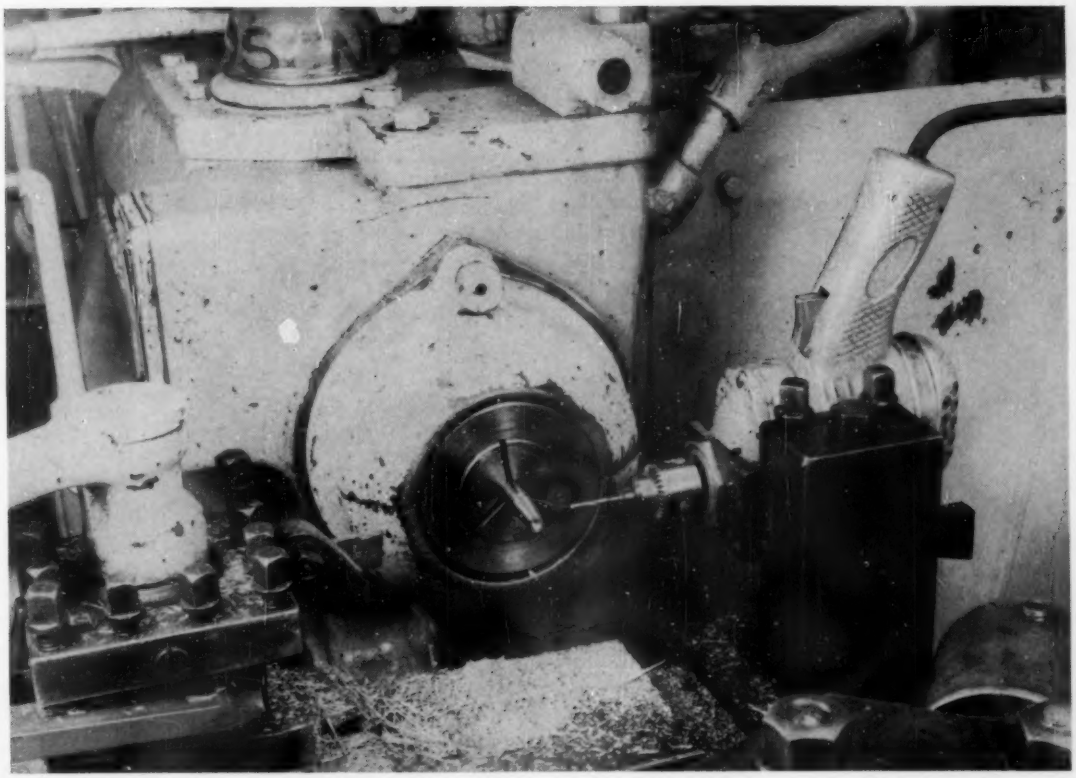


Cross Hole Drilling

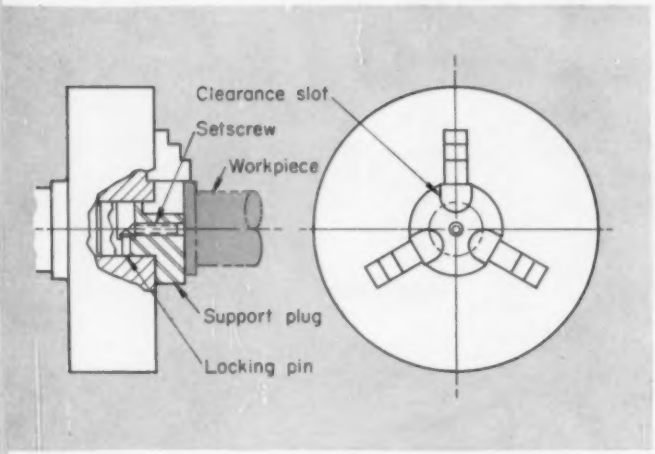
Prototype and research parts produced in small quantities require that tooling be improvised with available equipment to accomplish a job at reasonable cost. When a turret lathe job requires a diametral hole, it can be drilled on the lathe before the piece is cut off the bar with the setup illustrated.

A small portable electric drill is fitted with a special adapter which permits it to be clamped on a tool block on the rear of the cross slide. The drill is run forward by hand feed of the slide. Tapered parts can be drilled before the taper turning operation. In some cases it may be practical to use a two-lip end mill for drilling into a round without the guidance of a drill bushing. In any case, the drill should be as short as is practical to minimize deflection.

H. J. Gerber, Member-at-Large
Stillwater, Okla.



Gadgets



Workpiece Support Speeds Chucking on Small Areas

Difficulties incurred when relatively thin parts or parts with small shoulders are chucked can be eliminated with the illustrated work support. Turned or ground to fit the bored hole in the chuck, the support is held in position by a screw-actuated locking pin.

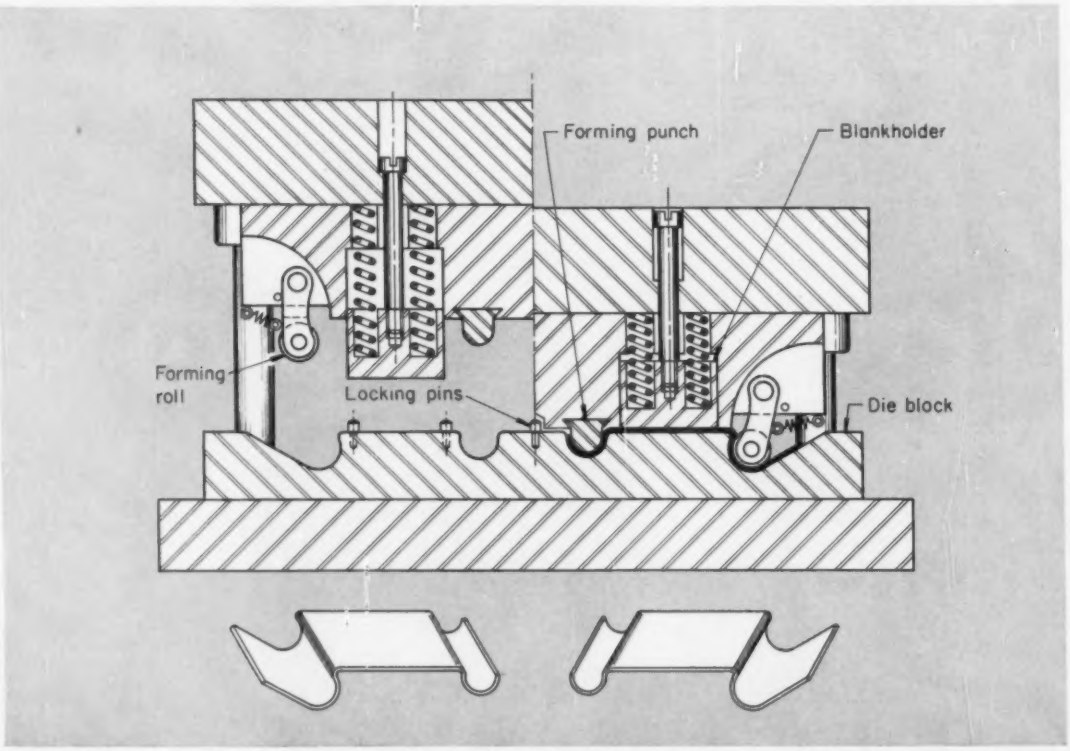
After insertion of the support, a light cleanup cut insures squareness of its bearing surface with the axis of the lathe. Milled clearance grooves for the chuck jaws are useful in extending the range of the device.

M. W. Loftus
Chicago, Ill.

Forming Operation Effects Metal Reversal

Two radial forming operations, one of which requires metal reversal past 90 deg, are accomplished in this die. The reverse bend is effected by a forming roll mounted in a movable axle. At die closure, the roll, held in a vertical position by spring pressure, depresses the metal into a U-shape. Continuing die closure then causes the rollers to move inward, forcing the stock to conform to the radial form in the lower die block.

Hjalmar Dahl, Uppsland Vasby, Sweden



controlled VIBRATION

key to parts-finishing efficiency

By T. W. Black
Senior Associate Editor

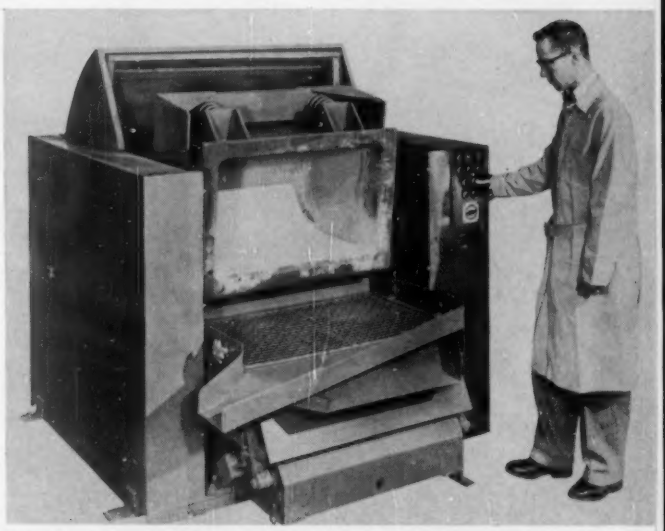


Fig. 1. (above) Vibratory finishing machine. The tub that holds the parts during finishing has just been emptied. The screen is part of a system for separating chips from parts. This machine is a Vibratron, made by the Roto-Finish Co., Kalamazoo, Mich.

Vibratory barrel finishing, once considered something of a novelty, has demonstrated its ability to cut parts-finishing time under production conditions. Almost any plant can benefit from the application of this versatile and fast finishing process.

DURING THE PAST FEW YEARS, automation has become a byword in American industry. Transfer machines, numerical controls, automatic machines of all kinds have been put to work in hundreds of plants. While the most dramatic developments have been in processes where large amounts of metal are removed, there have been equally important—if less dramatic—developments in the field of parts finishing, particularly barrel finishing, giving savings in time, floor space and human effort.

This quiet revolution, with its tremendous impact on manufacturing costs, has been the result of an intensive research effort on the part of the manufacturers of finishing eqipment and abrasives, as well as users of barrel-finishing processes. Some of the ancient bugaboos of barrel finishing—nicking of parts and a difficulty in obtaining reproducible results—have been overcome by adopting a more scientific approach to barrel finishing. It is now generally recognized that there is more to barrel finishing than simply dumping a mixture

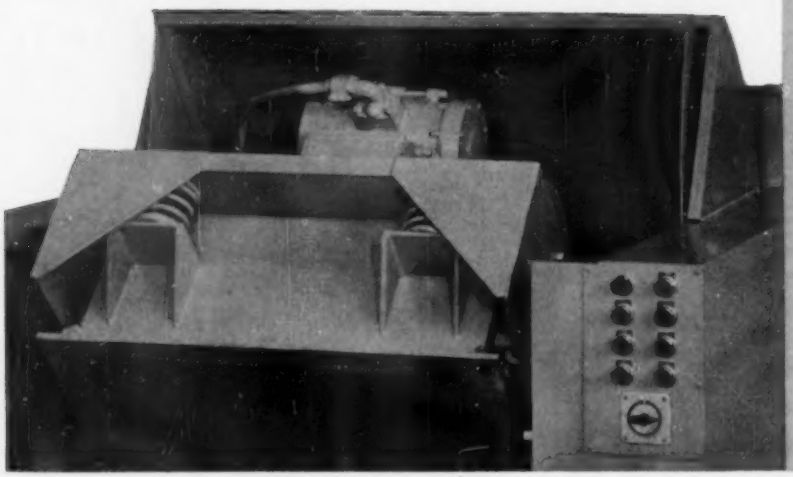


Fig. 2. (left) Vibratory motor is mounted on a frame beneath the tub of the Vibratron. The tub, mounted on springs, can vibrate freely. Amplitude of vibration is small but frequency is high (2500 cpm or more).

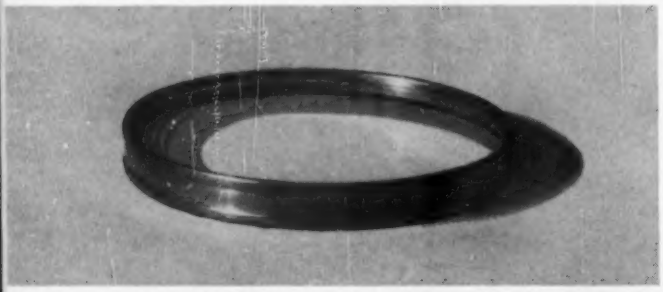


Fig. 3. Brass wear ring is deburred in three hours on a vibratory machine. Limestone chips are used.

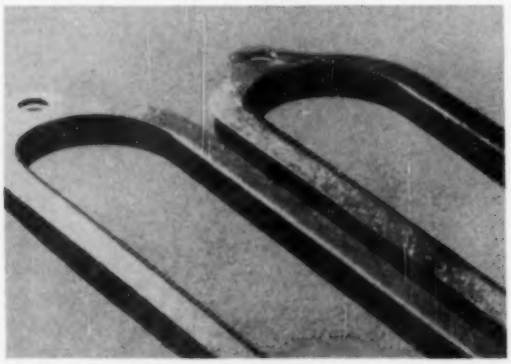


Fig. 4. Stainless-steel line protector is given a bright finish by vibratory burnishing.

of parts and abrasives into a barrel and pushing the start button. Today delicate or easily nicked parts are fixtured in the barrel to eliminate the possibility of damage and close attention is paid to operating variables, such as the type and size of abrasive, the ratio of parts to abrasive, the total load in the barrel, the amount of liquid and finishing compound added, and so on.

As a result, literally thousands of companies have been able to successfully put barrel finishing to work, with annual savings to American industry of millions of dollars.

The most common type of barrel-finishing equipment in use is the simple rotating barrel, usually octagonal in shape, which is partially filled with a mixture of parts, chips (sometimes called "media"), water and compound (soap, detergents, water softeners, fine abrasives and so on). As the barrel rotates, part of the mass is continuously lifted up in the direction of rotation. The top of the mass on the "up" side of the barrel continually slides back toward the "down" side of the barrel, forming a sliding layer. Most of the work done on the parts is accomplished in this sliding layer, which contains only a small percentage of the total number of parts in the barrel at any one time. Since the finishing action is intermittent, conventional barrel-finishing cycles may require many hours. It should be pointed out, however, that these are hours when no operator attention is required. The only cost involved is the cost of electricity for running the motor. (For a complete description of conventional barrel-finishing equipment and its applications, see "Fundamentals of Barrel Finishing" by T. W. Black, THE TOOL ENGINEER, April 1957, p. 109, and May 1957, p. 113.)

A more compelling disadvantage of conventional barrel finishing is its inability to finish part interiors, which are, of course, protected from the full force of the finishing action. These protected areas are ordinarily finished by hand—often a rather laborious process.

With the advent of vibratory barrel-finishing machines, the twin disadvantages of conventional barrel finishing—the long time cycles required and the inability to finish protected areas—have been overcome. These new machines cut hours off the time required for finishing, since the work is con-

tinuous, rather than intermittent, and the vibratory action forces abrasive particles through protected areas, where they can improve surface finishes, debur and perform similar operations that are normally performed manually.

Perhaps the simplest type of vibratory finishing machine is shown in *Fig.* 1. Parts are loaded into the tub, which is spring-mounted on a frame. A vibratory motor, *Fig.* 2, vibrates the tub during the finishing cycle. The tub-frame-motor assembly can be tilted for the removal of parts and a system of screens, and trays for separating liquid, parts and abrasive is mounted in front of the tub.

The tub does not rotate during the machine cycle; all finishing is accomplished by vibration. The mass of parts and media slowly turns over during finishing as a result of the vibration. This action is not violent and it does not damage or nick most parts; however, large and heavy parts may be fixtured to give maximum protection.

A leading manufacturer of fishing reels, Shakespeare Corp., Kalamazoo, Mich., reports excellent results with vibratory finishing. Careful deburring is essential on many fishing-reel components because of the danger of snagging a fishing line on a sharp edge. Also, the company's products are made to high standards of precision and surface finish. For many years, these requirements have been satisfied by conventional barrel finishing.

Shakespeare, which recently added several vibratory machines to its barrel-finishing department, finds that the vibratory process is definitely an improvement over earlier finishing methods. Cycle times are significantly faster than with conventional machines and, in at least one case, it has been possible to mechanically finish a high-production part that was previously finished by hand.

One part, a brass wear ring, *Fig.* 3, is deburred in three hours, as compared to eight hours by conventional methods. The vibratory finishing operation is for the purpose of deburring the edges of the ring and obtaining a smooth, bright surface finish on the inside surface. A combination of limestone chips, water and a nonabrasive finishing compound is used for the operation, which is performed at 2500 vibrations per minute.

Vibration finishing has materially shortened the time required to finish a stainless-steel line protector, *Fig.* 4. Two operations are required: deburring and burnishing. The deburring cycle requires five hours, using limestone chips and an abrasive finishing compound. Using the same type of chip and compound, conventional rotary barrel finishing took 48 hours.

The burnishing cycle takes 1½ hours, using 3/16-inch-diam steel balls with a small amount of water and detergent compound. Some seven hours were needed for burnishing the same part in a conventional barrel. Deburring is at 2500 vibrations per minute; burnishing is at 2200 vibrations per minute.

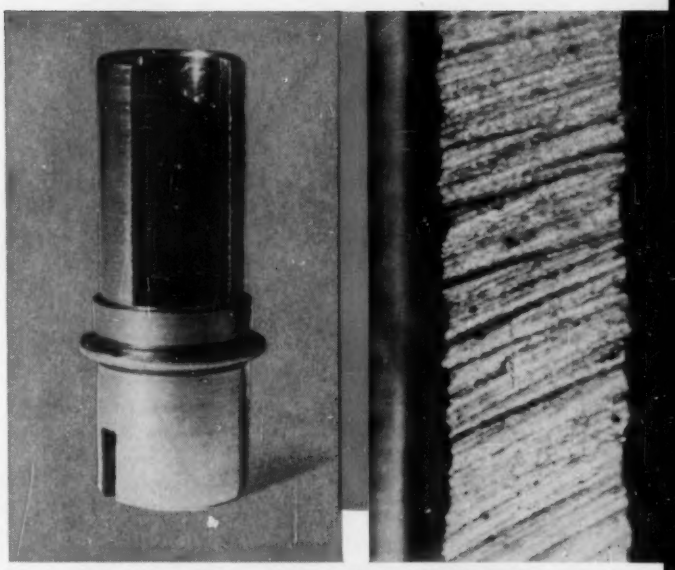


Fig. 5. Vibratory finishing deburrs the inside edge of this part (magnified at right), generates radii on sharp corners and imparts smooth surface finish.

It should be pointed out that the faster cycle times possible with the vibratory machines can materially reduce capital investment costs. Over-all cycle time for finishing the line protector is 6½ hours, as compared to 55 hours for finishing in a rotary barrel. Thus the vibratory finishing machine can outproduce over eight conventional barrels on this job, with substantial savings in initial investment, floor space and maintenance.

Internal deburring of an aluminum spool hub, *Fig.* 5, illustrates the ability of vibratory barrel finishing to reach hard-to-get-at areas. It was impossible to deburr this part satisfactorily on a conventional machine, even with a 20-hour finishing cycle. Consequently, it was necessary to hand-finish this part. Deburring in a vibratory machine takes six hours, using a shaped, ceramically bonded aluminum oxide chip. An abrasive compound is also used, with just enough water to keep the chips moist. Approximately 4000 pieces are deburred simultaneously in one seven-cu-ft-capacity barrel.

These examples, only a few of the many parts that have been successfully finished in vibratory machines at Shakespeare, are typical of the results that are being obtained by many other manufacturers. While conventional rotary finishing barrels are by no means obsolete, when large numbers of parts must be finished with high efficiency and speed, or when part configuration precludes the use of rotary barrels, vibratory machines are an obvious choice for most plants.

improving DIAMOND WHEEL —in electrolytic

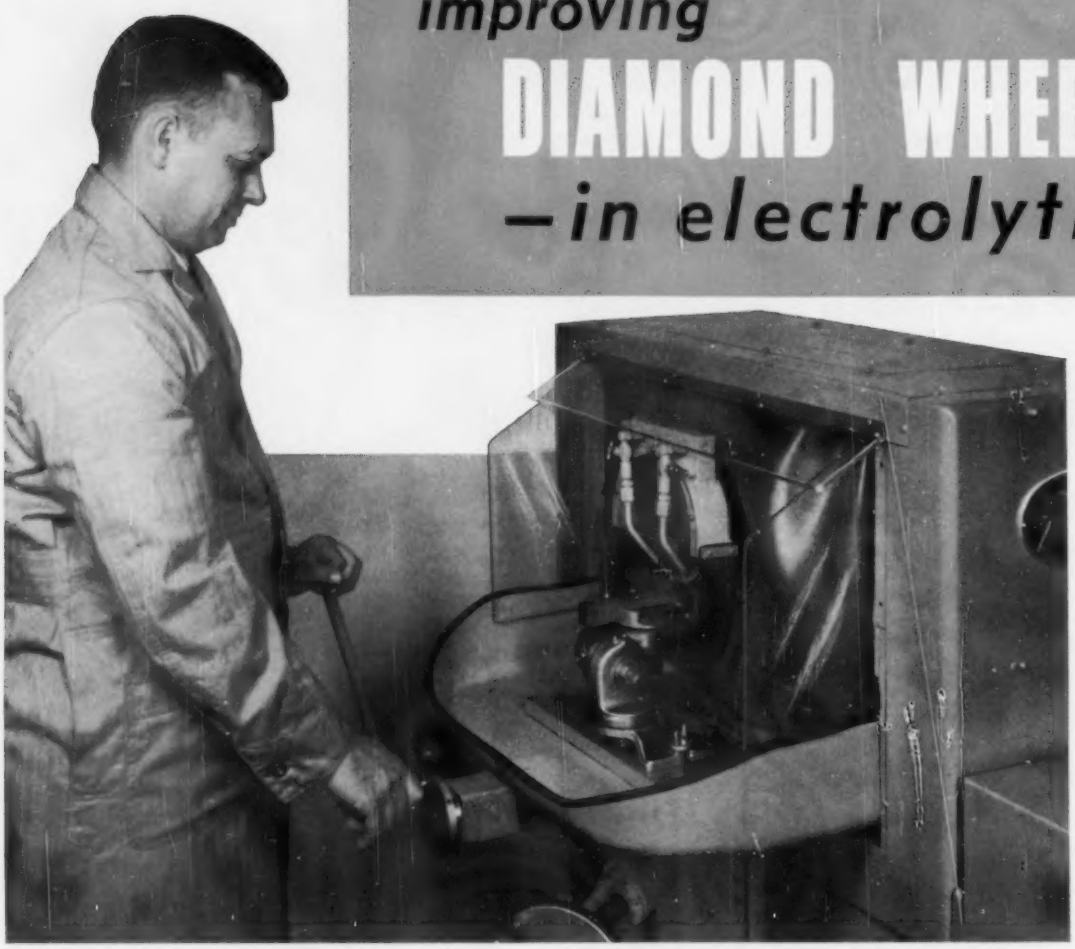


Fig. 1. Electrolytic machine grinding the tungsten carbide tip of a cutting tool.

By Rico R. Brandi
Superintendent
Machine Tool Research and Development
Ex-Cell-O Corp.
Detroit, Mich.

Although diamonds do little or none of the actual cutting in electrolytic machining operations, selecting the right type of diamond wheel, and preparing and maintaining that wheel properly, is important to over-all efficiency.

ELECTROLYTIC MACHINING is an electrochemical deplating process in which low-voltage current passes through a conductive fluid flowing between the workpiece and the metal bond of a diamond wheel. It is gaining wide application for cutting hard materials, *Figs.* 1 and 2, because there is little wheel wear and because there is no possibility of thermal damage to the workpiece. Fine finishes are produced in one operation and, considering the hardness of workpiece materials such as tungsten carbide, machining rates are relatively fast.

The diamond particles in wheels for electrolytic machining act as insulators and spacers; they do not actually cut metal. They prevent the conductive metal of the wheel from shorting out against the workpiece. They also wipe away oxide formed on the machined surface by the deplating action, exposing the surface for further machining.

Diamonds are ideal for this purpose since they do not conduct electrical current and have high resistance to wear. This wear resistance means that the optimum gap between the metal wheel and the workpiece (usually about 0.001 inch) can be held.

Diamond Wheel Selection: The shape of the piece to be machined determines the shape and size of the diamond wheel used. It is important that the wheel be shaped to present the largest possible area to the workpiece during machining, thus deplating a large area.

The size and type of diamond grit in the wheel are also important. The grit in the wheel should be fairly uniform in size. Since the wheel does not cut, sharp cutting edges are not required. Friable diamond that cracks and splinters is, of course, undesirable from the standpoint of wheel life.

The size and concentration of diamond grit in the wheel is determined by the size and contour of the workpiece. Grit size ranges from 40 to 200 mesh. In electrolytic machining, a much finer finish is achieved with any specific grit size than would be achieved in conventional grinding with wheels impregnated with the same size grit. This allows larger, more durable grit to be utilized.

A diamond concentration of approximately 100 is recommended for wheels used in electrolytic offhand tool grinding. This concentration of diamonds provides proper insulation, slower rate of wheel wear, and assures even distribution of the electrolyte over the workpiece at the contact pressures of the electrolytic process. The depth of the diamond-impregnated matrix on the wheel surface is usually from 1/32 to 1/8 inch. For offhand grinding of carbide tools, 1/32 to 1/16 inch depth is adequate.

The sintered metallic matrix that holds the diamond particles must be a good conductor and must not be insulated from the mounting flange. Different wheel makers use different matrix compositions. The matrix must hold the diamonds securely so that they do not dislodge and it must be of such hardness that oxides wiped off the workpiece do not become impinged upon the wheel surface, inhibiting current flow.

It is also desirable that the matrix surface be porous so that the volume of electrolyte around each diamond spacer is increased. This feature of the "ideal" electrolytic machining wheel is illustrated by the diagrams in *Fig.* 3.

The machine tool builder will recommend the best wheel type for a particular job when the machine is installed. If additional diamond wheels are purchased for the machine, it is advisable to request performance data on the wheels offered by the various makers. The performance data is usually a good indication of the amount of experience the wheel maker has had in producing special wheels for electrolytic machining. This is a field in which actual production experience is helpful.

Preparing Wheels for Use: New electrolytic machining wheels must be conditioned before use to obtain optimum performance. The first step in

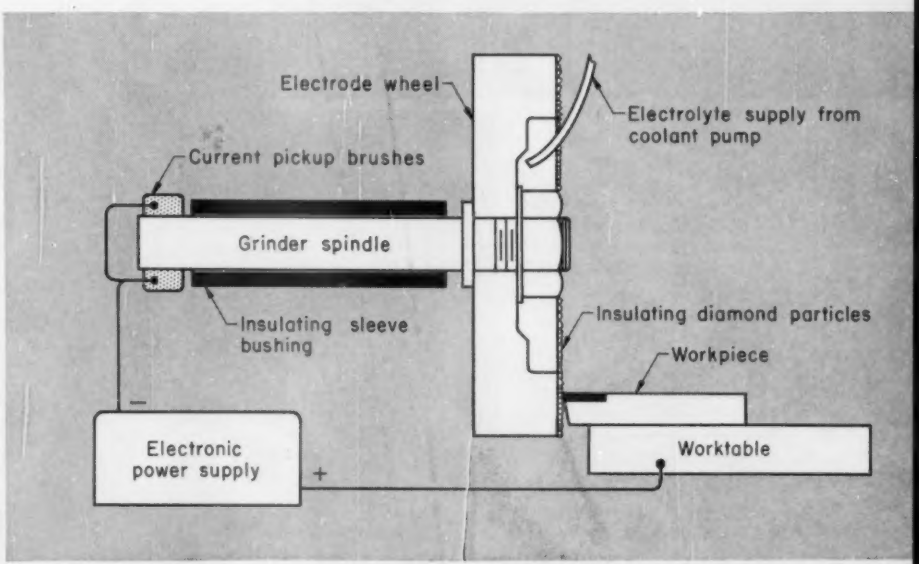


Fig. 2 Principle of electrolytic machining. The electrolyte flowing between the negatively charged wheel and the positively charged worktable causes a deplating of the workpiece. Diamond particles on the face of the wheel maintain the correct gap between the wheel and the workpiece. The polarity is reversed to deplate a new wheel when establishing the gap.

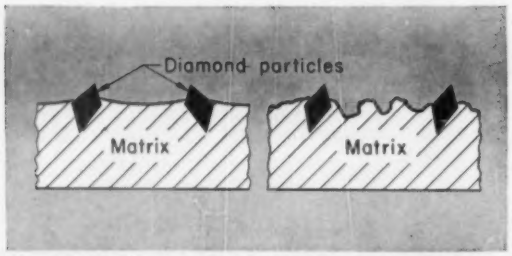


Fig. 3. Smooth, flat matrix (left) provides little area for entrapment of electrolyte. A deplated matrix (right) has an irregular and porous surface that has a greater capacity to carry electrolyte.

conditioning is to mount the wheel on the machine, and adjust it so that the face of the wheel runs as nearly to perfect trueness as possible. The wheel should be within 0.001 inch of absolute trueness at all times. An out-of-true face will "bounce" and consequently wear unevenly.

The next step in conditioning a new wheel is to establish the proper protrusion of the diamond particles from the matrix in order to obtain the required gap. In unused diamond wheels, the metal matrix almost entirely covers the top layer of diamond particles. The overlying matrix of the wheel is removed by reversing the polarity of the wheel and worktable, and bringing a deplating shoe (a bar of copper, brass, or steel) in contact with the revolving wheel until the diamond spacers protrude and form a gap about 0.001 inch wide, as illustrated in *Fig.* 4.

Initially, there will be some wear of any diamond particles that have sharp protruding points. When the edge has been taken off the sharp points, the rate of wear reduces. Because of initial wear, it is sometimes necessary to deplate the wheel a second time to re-establish the desired gap. Deplating should be kept to a minimum. Excessive deplating can cause the diamonds to loosen from the matrix.

Operational Care: Once the new diamond wheel has been run in and the spacers flattened to a slow-wearing condition, the wheel requires little maintenance. The wheel face should be cleaned of oxides occasionally with a pumice or abrasive stick, *Fig.* 5. The rate of feeding work into the wheel should be such that stock removal results from optimum electrolytic action rather than abrasive action of the wheel.

Important wheel care precautions for the machine operator are:

1. Never attempt to machine a piece when the current is reversed. The machine should be in reversed polarity only when the deplating shoe is being used.
2. Avoid having the wheel charged when it is not rotating. Touching a charged wheel with a workpiece when the wheel is not turning will cause damage to the wheel.
3. Maintain an ample flow of electrolyte between the wheel and the workpiece. Poor cutting characteristics and excessive arcing are indications that electrolyte flow is too low.

When these precautions are followed, optimum wheel life and performance should be obtained.

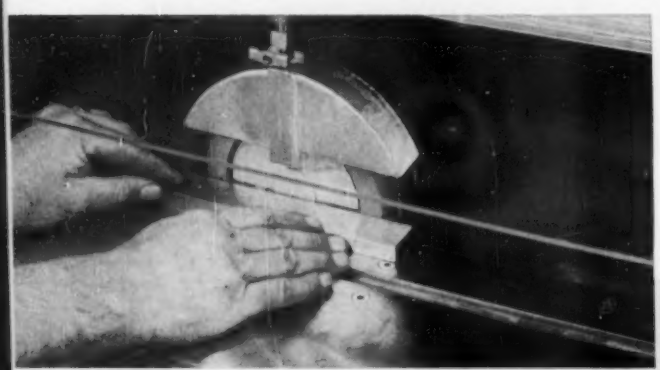


Fig. 4 (above). A deplating shoe (a bar of copper, brass or steel) is brought into contact with the rotating wheel while the polarity of the electrolytic machine is reversed. This establishes the correct gap.

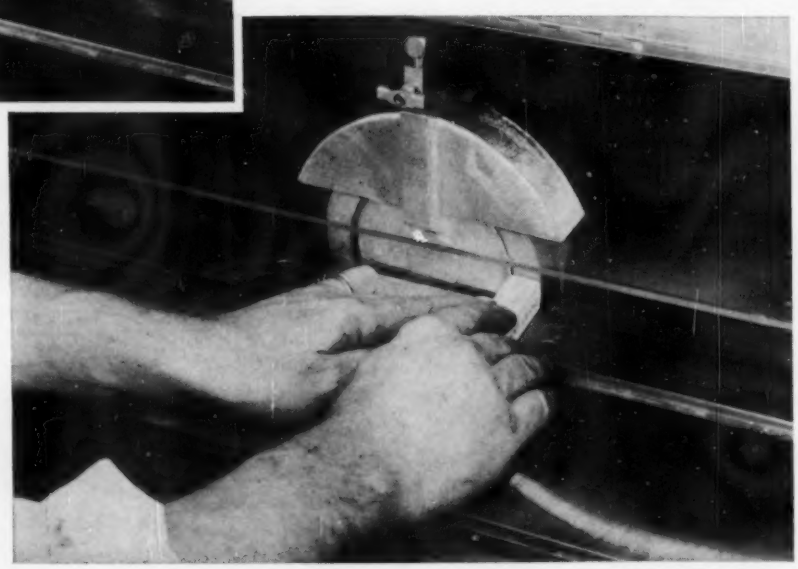


Fig. 5 (right). Oxides are removed from the face of the wheel with an abrasive stick.

how to use
POSITIONAL TOLERANCES
Part 2—Gaging Tolerances

By Edward S. Roth
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Incompatibility between bilateral tolerancing and fixed feature receiver gages causes parts that are actually interchangeable to be rejected. This incompatibility and waste can be eliminated by using tolerances referenced to the "maximum material condition."

GAGES ARE USUALLY DESIGNED to check the positional tolerances of a part, even though most drawings express gaging criteria in terms of bilateral tolerances. An incompatibility exists that often causes rejection of parts that are actually interchangeable. The drawings imply square and restrictive tolerance zones. The usual gages automatically allow feature location tolerances to vary in proportion to feature size. For this reason, parts that pass gage inspection may not pass inspection by open-setup inspectors, even though tolerance specifications are identical. The reason for this is that open-setup inspectors usually freeze the setup, and check specified and constant tolerances regardless of feature size.

The incompatibility of bilateral tolerances with gaging is shown in *Fig.* 1a. The designer's intent is to fasten two identical plates together with 0.500-inch-diameter bolts. Tolerances indicate two 0.020-inch-square tolerance zones for hole center location. In gaging this part, as in *Fig.* 1b, using two 0.508-inch-diameter gage pins fixed at nominal hole locations, two different tolerances are actually allowed for hole location. For a 0.528-inch hole, tolerance is ±0.010 inch; for a 0.538-inch hole, the gage will allow the hole center to be off nominal position by as much as 0.015 inch.

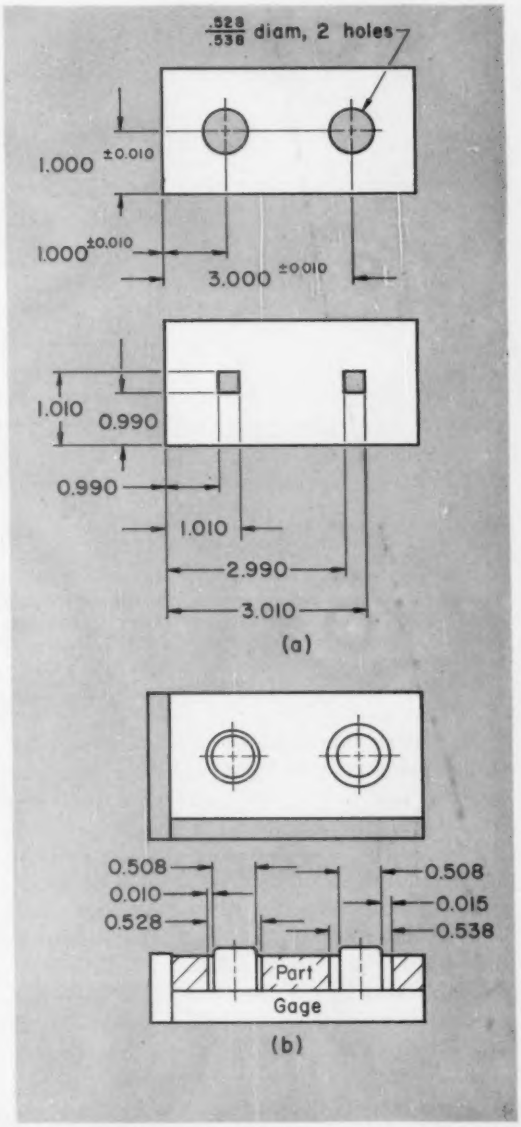


Fig. 1. (a) Conventional bilateral tolerances indicate square tolerance zones for hole center location, regardless of size. (b) The gage actually checks to a circular tolerance that varies with hole size.

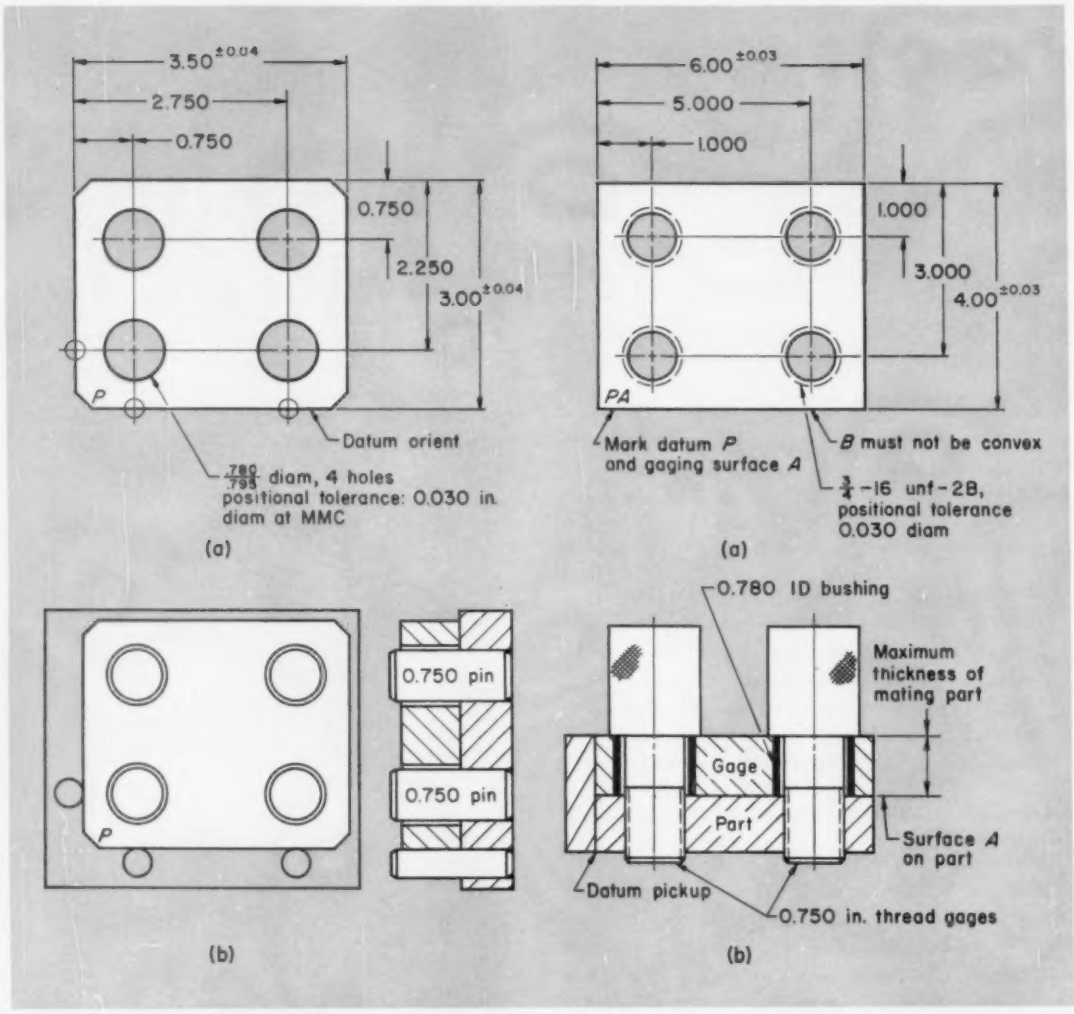


Fig. 2. (a) Positional tolerances can be referenced to the MMC of an internal part feature. (b) Gage designer subtracts tolerance from the MMC dimension to determine gage pin size.

Fig. 3. (a) An external feature, the ¾-16 bolt, directs the gage design to add tolerance to MMC. (b) The gage bushing ID is determined as the MMC dimension plus positional tolerance.

Maximum Material Condition: True interchangeability can be gaged when the maximum material condition (MMC) concept is employed. An external feature, such as a bolt or pin, is at MMC when it is at maximum specified size. An internal feature is at its extreme limit of acceptability or MMC when it is at its minimum specified size. As shown in *Fig.* 2a, the drawing directs the gage designer to subtract tolerance from the MMC hole size. That is, the plate is at MMC when hole diameter is 0.780 inch. Subtracting positional tolerance, 0.030 inch, establishes that 0.750-inch pins, as shown in *Fig.* 2b, gage interchangeability.

Tapped holes in the part shown in *Fig.* 3a accept bolts when this part is assembled to some mating part. The gage, *Fig.* 3b, simulates the bolts by using thread gages. Since the bolts are at MMC

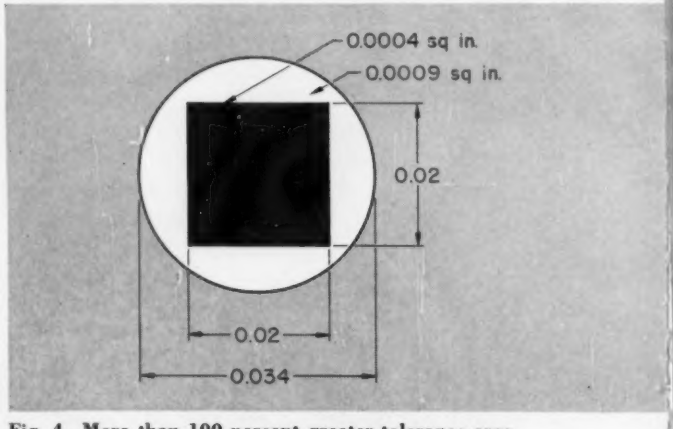


Fig. 4. More than 100 percent greater tolerance area is allowed by MMC tolerancing (circle) than by bilateral tolerancing (square).

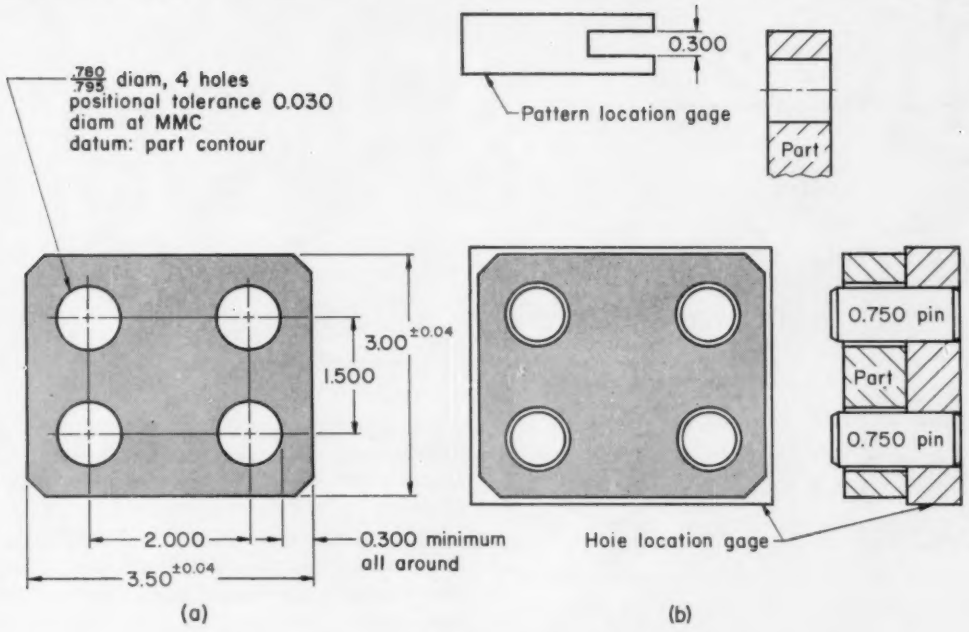


Fig. 5. (a) Since the hole pattern is more important than location on the part, the part contour is selected as the datum. (b) Gaging, designed to this datum and the MMC concept, will not reject interchangeable parts that would be rejected by conventional tolerancing.

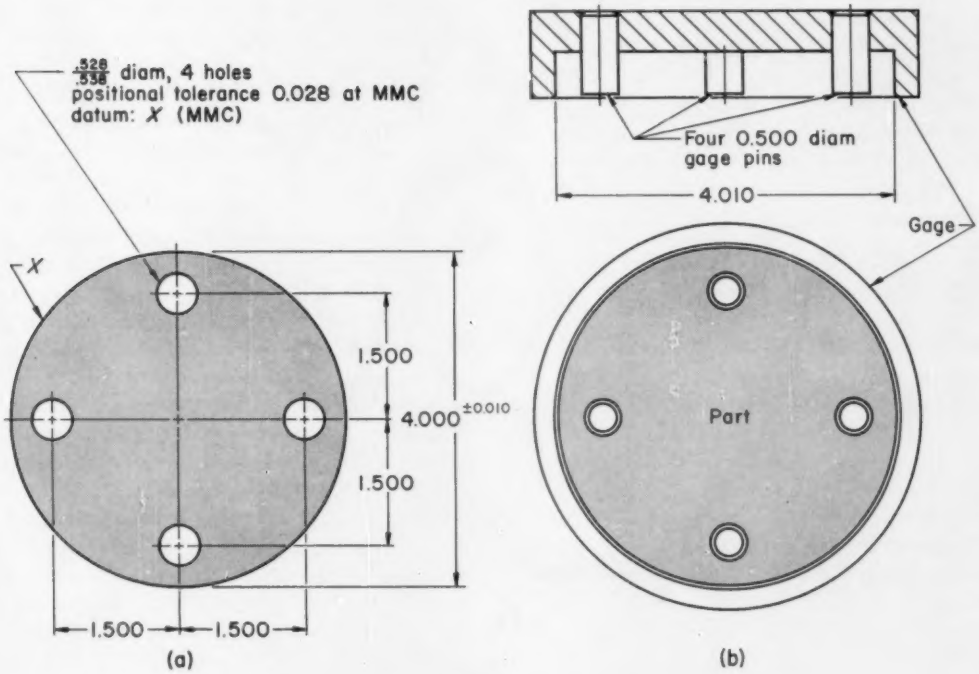


Fig. 6. (a) Diameter *X* is selected to serve as a datum when it is at its most critical interchangeability condition (MMC). (b) Gage design allows part to shake if it is not at MMC.

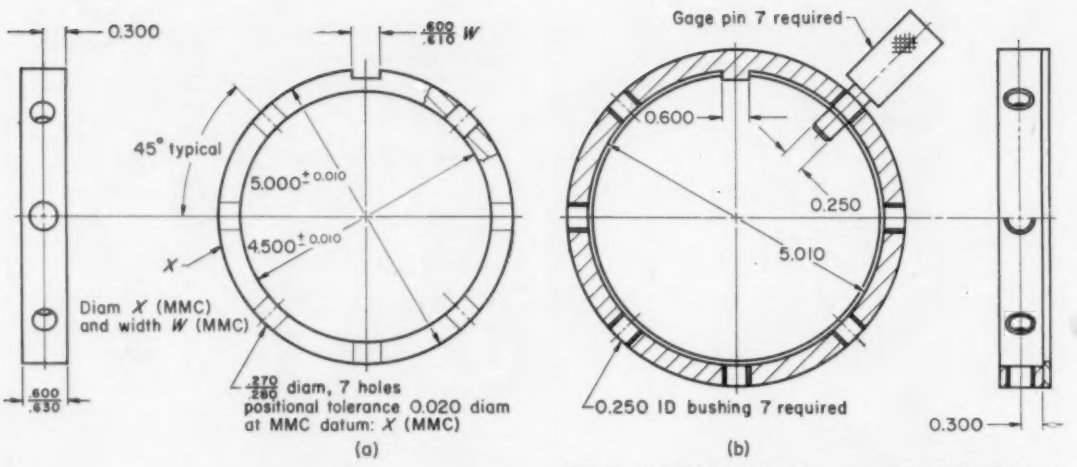


Fig. 7. (a) Positional tolerance of the radial holes is referenced to two datums, both selected at MMC. (b) Any part not at MMC can shake in the gage.

when they are at the maximum specified size (0.75 inch), the positional tolerance (0.030 inch) is added to bolt size to determine nominal gage feature size (the 0.780-inch ID bushings). The bushings are set in a gage whose thickness is equal to the maximum thickness of the mating part. By gaging to the marked surface (important on symmetrical parts) the gage verifies that the bolt shank will pass through the clearance hole.

Use of the MMC concept can increase the tolerance allowed by over 100 percent without affecting actual interchangeability of parts. In the drawing in *Fig.* 1, for example, if the hole location tolerance were referenced to MMC, tolerance would be indicated as a 0.028-inch-diameter circle and a 0.500-inch gage pin would be used. With the hole at nominal size with a 0.534-inch diameter, positional tolerance would effectively be a 0.034-inch-diameter circle. This more than doubles the area of positional tolerance, as shown in *Fig.* 4.

Gaging Interchangeability: Functional acceptability of many parts is often more dependent on the pattern of part features, such as holes, than on where the pattern occurs. This typical situation is shown in *Fig.* 5a. The pattern of the holes is more important than where they are located on the part. Use of the corner as a datum is avoided because there is no real functional relationship between any one corner and the hole pattern. Gaged as shown in *Fig.* 5b, more tolerance is allowed between the part perimeter and hole pattern than if one corner had been used as a datum instead of the part contour. At the same time, referencing positional tolerance to MMC allows all interchangeable parts to be accepted by the gage.

When design layout indicates that strict alignment is not essential for the functioning of two parts, tolerances can be specified as in *Fig.* 6a and gaging accomplished as in *Fig.* 6b. The most critical interchangeability condition of MMC exists when the part diameter is 4.010 inches. This dimension becomes the nominal ID of the gage. The gage thus represents the mating part at its most critical interchangeability size. The part can move or shake in the gage whenever the part diameter is less than 4.010 inches. The callout "Datum X (MMC)" states in effect that the center of diameter *X* can be a datum only when *X* is at MMC.

The workpiece shown in *Fig.* 7a has two datum features (diameter *X* and width *W*) and a radial hole pattern. The MMC dimensions of both *W* and *X* are used to design the gage, *Fig.* 7b. Gage pin diameter is the MMC hole diameter (0.270 inch) less the 0.020-inch positional tolerance. Any part that is not at its most critical interchangeability size can shake or rotate in the gage through the amount of movement allowed by the pins. By designing the gage using tolerances referenced to MMC, both inspection and the part designer are assured that the gage will not reject any part that is actually interchangeable. Gaging reworked parts is simplified also. For instance, if a piece is reworked after rejection for outsize OD, it is simple to determine whether the rework enables the piece to meet interchangeability requirements.

By using the MMC concept, gages can be designed to accept every interchangeable part and to reject all others. Since the gage usually resembles the mating part closely, the actual difference in size between a feature on the part and a feature on the gage determines acceptability. Confusion and doubt regarding acceptability are minimized. Some of the differences in rejection rates between gaging and open-setup inspection operations are eliminated, since true acceptability is better defined. How open-setup inspection can be improved in this respect will be indicated in the third part of this series on positional tolerancing.

designed for

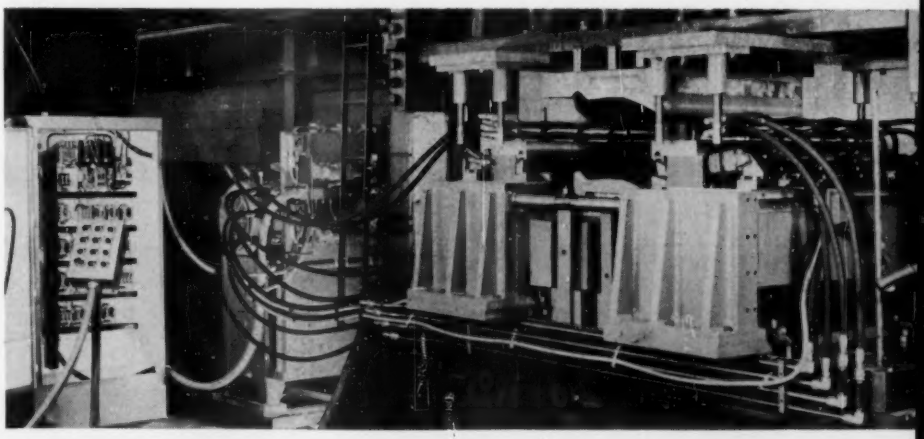
PRODUCTION

Stretch Forming Without a Draw Ring

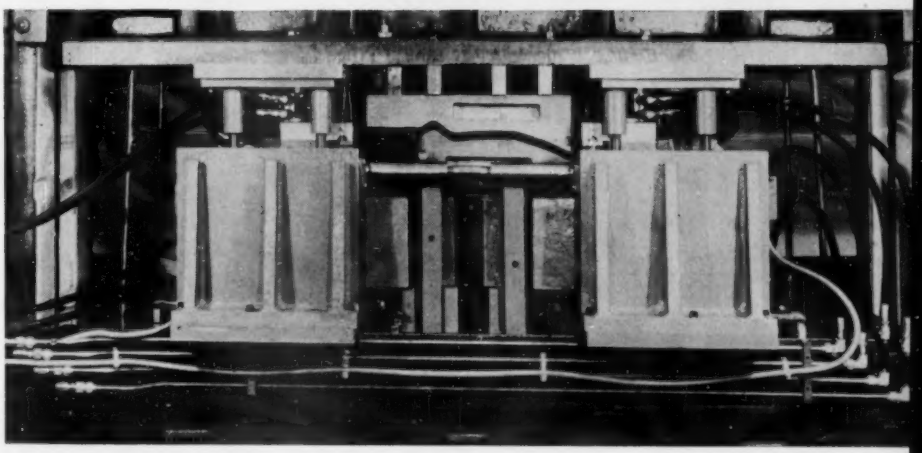
Metal stretch, normally attained through use of a draw ring, is accomplished by a stretching attachment in this setup. The attachment is loaded by placing a sheet between the serrated jaws shown at either side of the die. At the start of the cycle, hydraulic cylinders, activated by initial slide movement, close the jaws and stretch the sheet above the lower die. Requisite holding power is obtained by controlling hydraulic flow to the cylinders.

Adjustable screws are utilized to synchronize movements of the sheet and upper die. In this way the jaws and the metal they hold are depressed just ahead of the closing die.

Designed and built by The Cyril Bath Co., Solon, Ohio, this mechanism eliminates surface waviness by the stretch it provides before die closure. In conventional press operations, metal stretch cannot begin until die action is initiated.



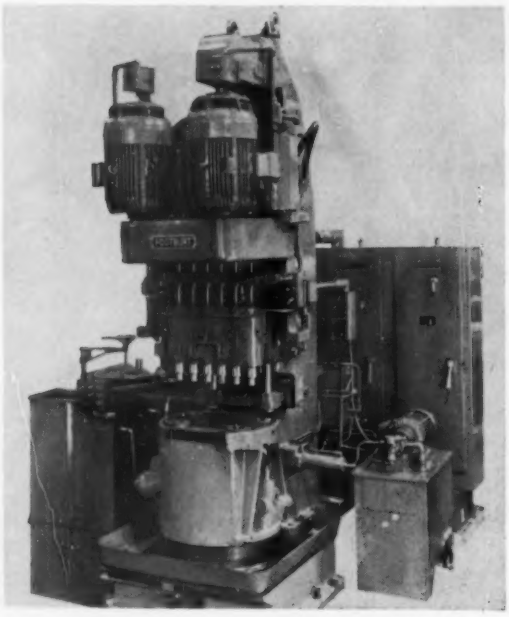
DIE IN OPEN POSITION for loading. Electrical control cabinet and hydraulic pressure system are shown at left.



DIE CLOSURE at 180 deg. Press tool consists of punch and die only.

DESIGNED FOR PRODUCTION

Indexing Machine Performs Multiple Operations

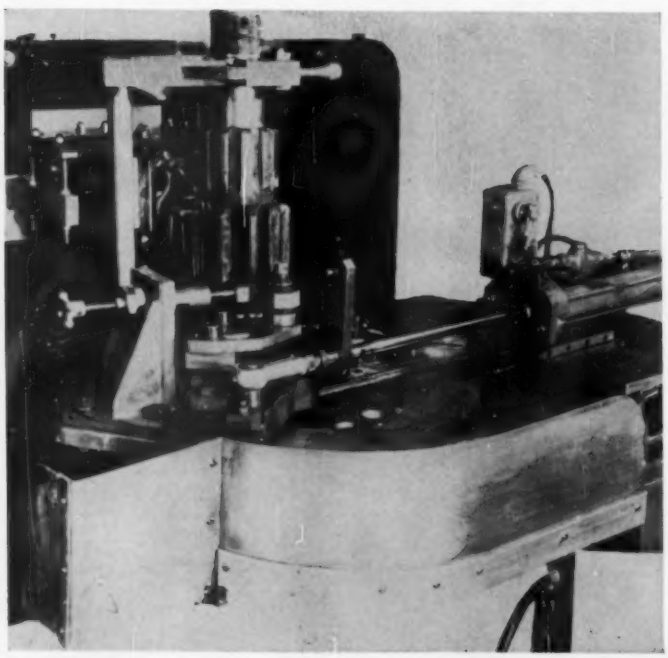


Twenty-four valve-guide machining operations are accomplished by six spindles in this machine. Multiple operations are made possible by a double operation at each spindle and by an indexing workpiece fixture.

A cutter on each quill machines the valve seat and chamfers a 130 deg clearance angle. The quill retracts and acts as a guide bushing for a gun-bore spindle within the quill. A tool in this spindle completes machining of the valve-guide hole.

When all machining is complete on one side of the head, the fixture is indexed and identical holes on the opposite side are machined.

Induction Fixture Hardens Gear Teeth



Induction heating is utilized to harden gear teeth in this indexing fixture, a development of the Induction Heating Corp., Brooklyn, N. Y. The hardening is accomplished by indexing the gear teeth through a heat zone and then through a quenching area.

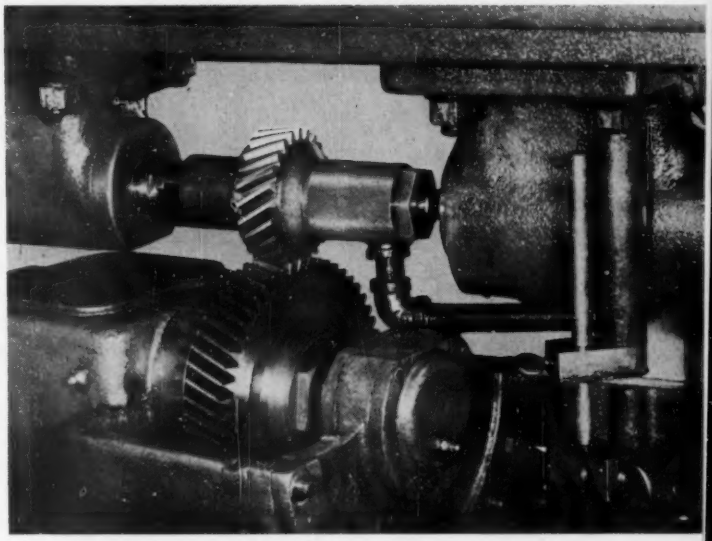
In setup, a bearing in the table and an upper bearing clamp support and hold the workpiece in place. Upon initiation of the cycle, a pawl, actuated by a pneumatic cylinder, indexes the pinion, carrying each tooth through heat and quenching areas. Time intervals may be varied to allow for correct heating of each tooth.

Control Unit Eliminates Cutter Breakage

Cutter damage resulting from excess workpiece stock is eliminated in this gear shaver by a current monitoring system. In operation, current flowing through an electric control unit energizes a solenoid which activates an air feed cylinder. This, in turn, moves a feed wedge which forces the shaving cutter into the workpiece.

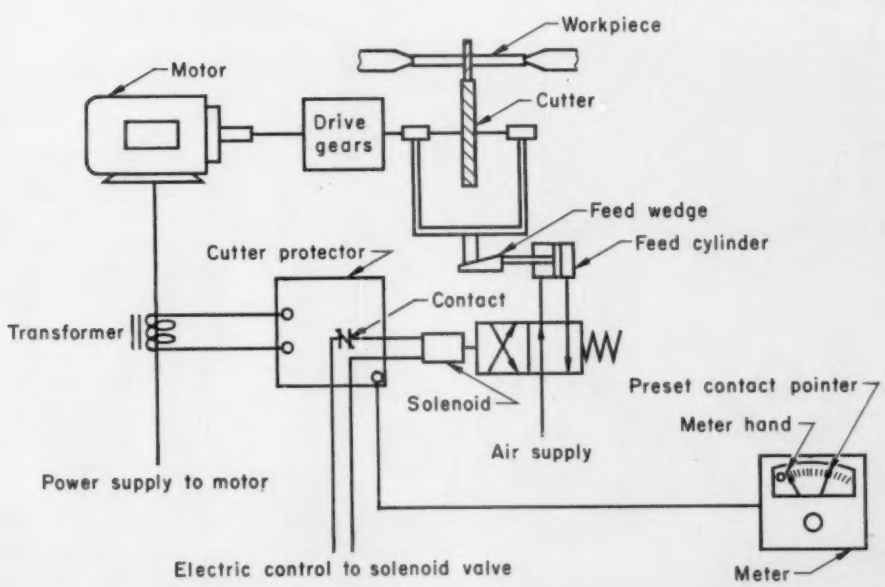
Should the workpiece be oversize, the current required for machining rises sharply. When it exceeds a preselected value—the maximum amperage permissible for safe machining—the current de-energizes the solenoid, causing retraction of the feed wedge.

Both the monitoring device and the gear shaver are products of Michigan Tool Co.



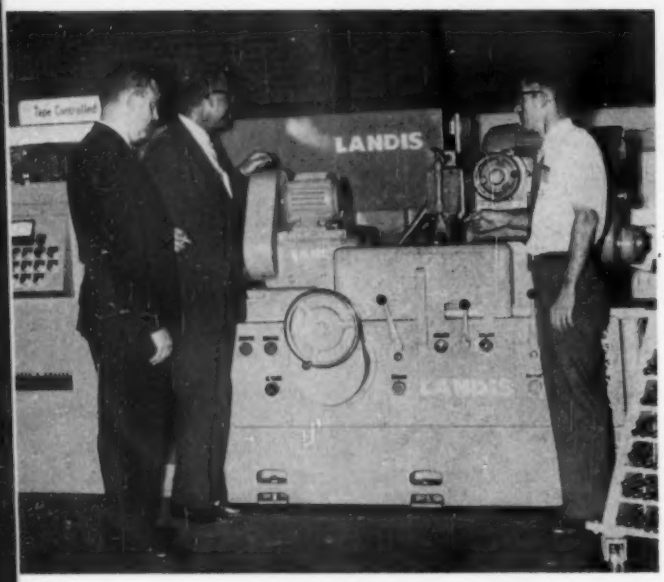
GEAR SHAVER putting the finishing touches on a helical gear. Lower unit rises vertically to a preselected height.

DIAGRAM of the monitoring system. Contact meter is for establishing current level and for visual inspection of rough sizes.



DESIGNED FOR PRODUCTION

Tape Control and Electronic Gaging Simplify Cylindrical Grinding

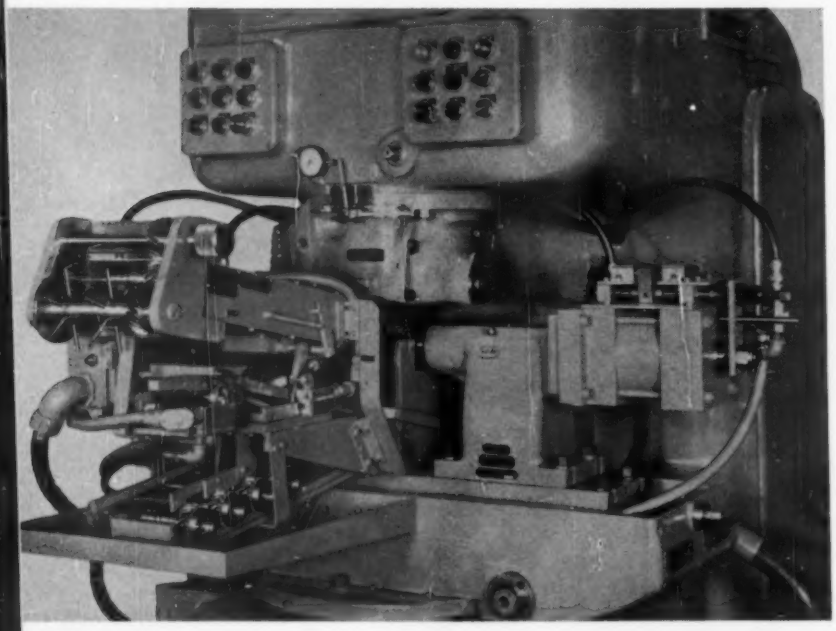


Virtually all machine functions including in-process inspection are tape controlled in this Landis grinder. Other functions include wheelhead and worktable positioning. Operator functions are limited to part loading and initiation of the machine cycle.

After a part is loaded, hydraulic power moves the wheelhead to a preselected position by taped commands. This is accomplished while the head is in its rear position. Simultaneously, the worktable is hydraulically positioned to align the workpiece with the wheel.

Gaging is accomplished by an electronic gage which moves into operative position during grinding. When requisite dimensions have been reached, the gage signals a withdrawal command to the wheelhead and the cycle is complete.

Inspection Gears Prevent Cutter Overloading



Designed to protect gear-shaving cutters from the dangers of oversize workpieces, this machine utilizes two master inspection gears at the entrance of its feed chute. To enter the chute, the workpiece must mesh with, and pass between, the master gears. Both gears are free-floating units.

Workpiece loading in this machine—a product of National Broach and Machine Co.—is performed manually. Parts too large to mesh with the inspection gears are placed by the operator in a reject bin for additional machining. Those that pass are fed into the tooling area by an air-actuated slide.

for the job shop

By R. M. Radl

Advanced Programs
Fabrication Engineering
Collins Radio Co.
Cedar Rapids, Iowa

Most applications of plastics tooling have been in the aircraft and automotive industries where bulky tools are required. Plastics can also save time and money when fabricating orthodox job-shop tooling.

DESPITE THE ABILITY of plastics tooling to save time and money, many companies still hesitate to put plastics to work. Two factors account for this. First, there is a prevailing belief that the preparation of the necessary resins, hardeners and fillers is a laboratory technique and therefore out of place in production toolmaking. Second, many companies have made hasty experiments with plastics, met with failure and have consequently condemned all plastics tooling.

While it is true that plastics resins must be compounded carefully and accurately, this task is well within the ability of the average toolroom worker. Also, the explicit working directions and technical assistance furnished by the resins formulators go far toward assuring the success of plastics tooling.

The misapplication (and resulting failure) of a plastics tool usually occurs when the physical properties of the resin have been ignored by the tool designer. Plastics for tooling are characterized by certain weaknesses which the tool engineer must take into account.

For example, the temperature resistance of plastics is low. No plastics tool should be contemplated where process heat (or generated heat) begins to approach 200 F. At this temperature, resistance to abrasion begins to drop rapidly.

Also, plastics are primarily insulators, thermal as well as electrical. Their inability to quickly conduct and disperse heat means that they are subject to spot surface temperature build-ups. In a plastics tool, this can result in distortion and eventual breakdown of the surface.

The physical properties of plastics do not, of course, equal those of the metals normally used in toolmaking. The best plastics tool material will possess physical characteristics approximating those of cast iron. Such a material will fail if it is set up to do the work of a medium-carbon forging quality steel. The tool engineer must be realistic and apply the basic formulas dealing with the strength of materials to each plastics tool application.

The basic raw materials used in plastics toolmaking are a tooling resin, liquid in form; a catalyst or hardener, also liquid; and a filler. The type of filler used—steel or aluminum powder, silica, clay, glass cloth and so on—depends on the need for wear resistance and strength.

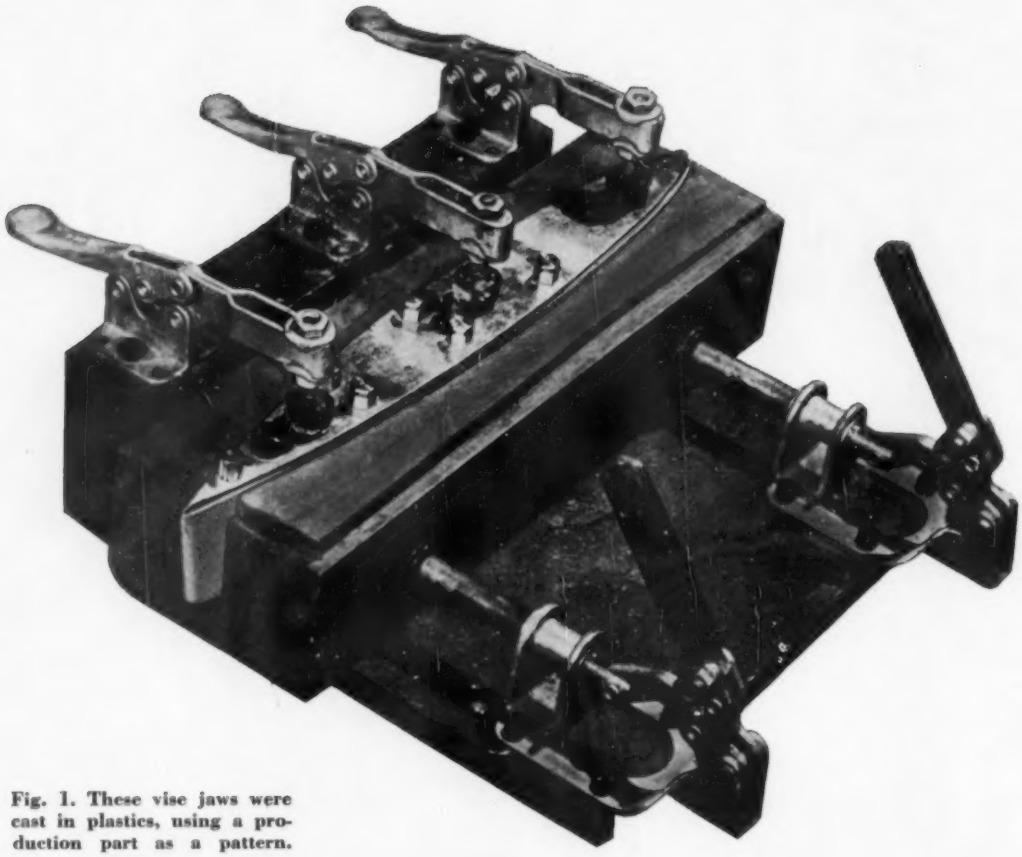


Fig. 1. These vise jaws were cast in plastics, using a production part as a pattern.

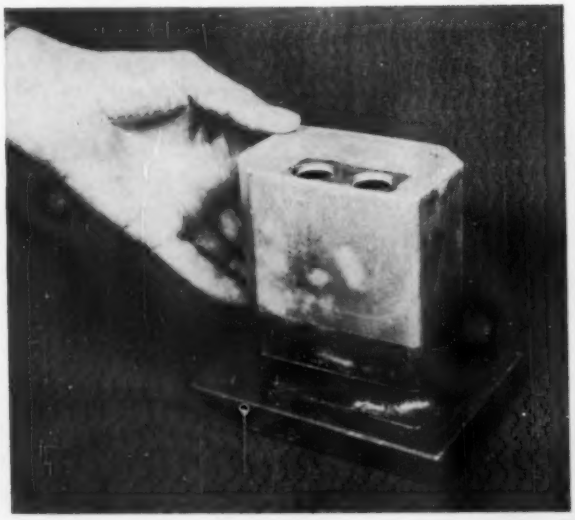


Fig. 2. Can is slipped over a plastics mandrel for support while counterboring two holes.

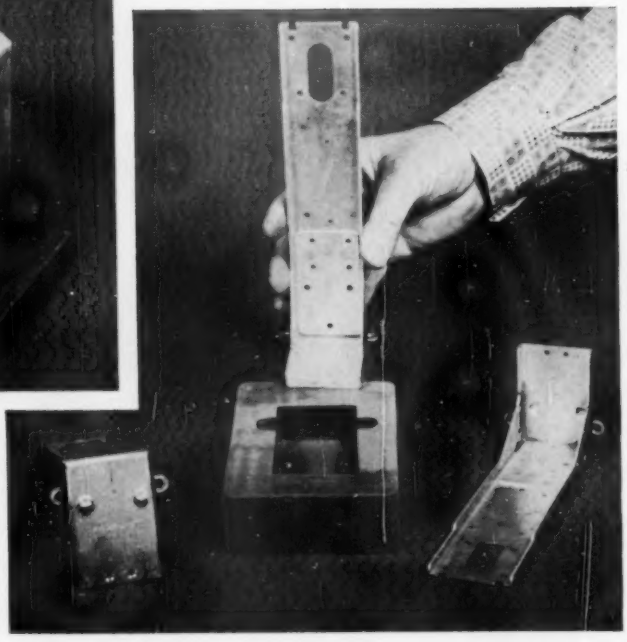


Fig. 3. (right) Plastics holding fixture supports bracket for machining of holes in projecting ears.

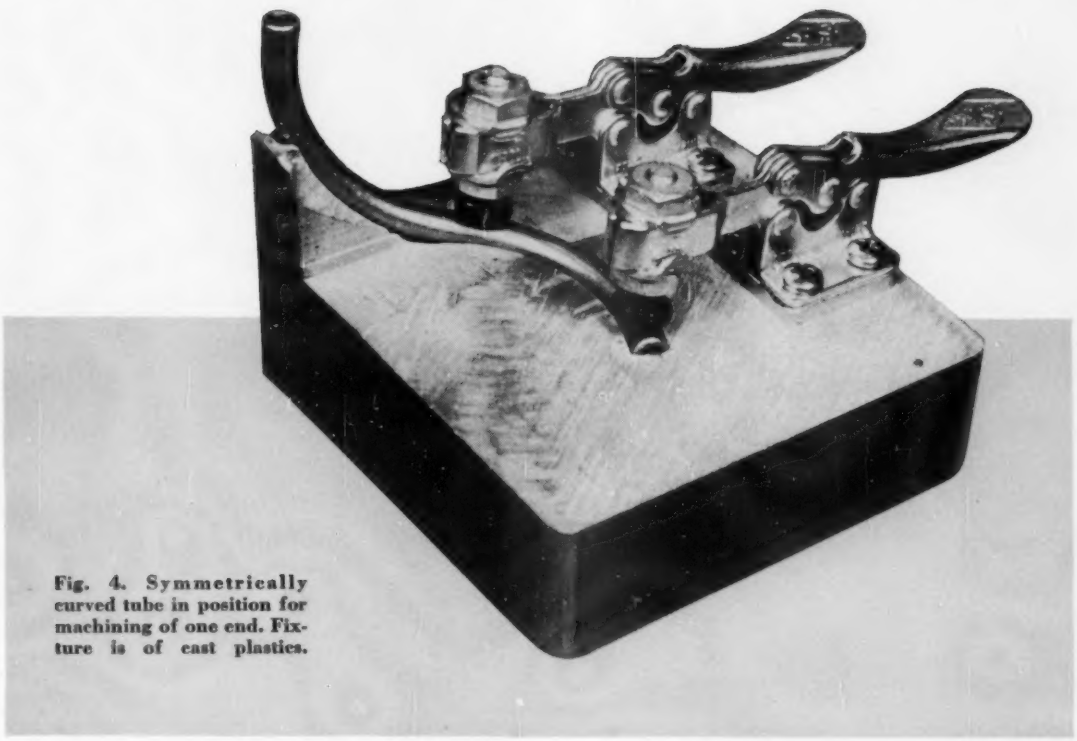


Fig. 4. Symmetrically curved tube in position for machining of one end. Fixture is of cast plastics.

To fabricate a plastics tool, the resin and catalyst are carefully proportioned, usually by weight, and thoroughly mixed. A filler is then stirred into the liquid and the mixture is poured over a master pattern. The pattern is mounted within the confining walls of a frame or flask to control the size of the finished casting. After an interval for curing (either in an oven or at room temperature) the pattern is removed from the casting, leaving a cavity which duplicates the pattern in reverse.

This direct casting method is used to make snug-fitting vise jaws, gages, checking fixtures, drill jigs, holding fixtures and similar tooling. Usually the production part itself serves as the master pattern, eliminating the need for a fabricated pattern.

This was the case with the contoured vise jaws shown in *Fig.* 1. The vise is used to hold an antenna shell during assembly operations. In making the jaws, epoxy tooling resin, with an aluminum filler, was poured over a production part. After oven curing, the pattern was removed from the casting and the casting was sawed into two halves along the long axis of the antenna. The total labor time to fabricate the plastic jaws was three hours, as compared to an estimated labor time of 42 hours to machine the jaws in steel.

A plastics mandrel is shown in *Fig.* 2. It is designed to hold a can (shown in position on the mandrel) for counterboring of the two top holes. In this case, the can itself was filled with catalyzed resin which, when cured, formed an exact reverse duplicate of the inside of the can. So exact was this duplication that the corners of the plastics mandrel had to be relieved to provide the required slip fit. The labor time to make the plastics mandrel was 30 minutes. About 10 hours would have been required to machine a steel mandrel.

A simple plastics holding fixture is shown in *Fig.* 3. This fixture is used to firmly seat a bracket while counterboring holes in two projecting ears. The bracket itself was used as a pattern. Modeling clay was built up on the ears and on the inside surface of the bracket to produce a well or open area in the plastics casting. In plastics, the holding fixture was produced with 1½ hours of labor. Machining of an equivalent steel holding fixture would have required some five hours.

The fixture illustrated in *Fig.* 4 holds a symmetrically bent copper tube in position for machining. A light cut is taken on each end of the tube. In making this fixture, a production tube was completely encapsulated in tooling resin. The resulting casting was cut open to the approximate parting line of the tube, as shown. Total labor time for the plastics fixture was 1¾ hours, as compared to 15 hours for a comparable steel fixture.

These examples demonstrate the ease of use and versatility of plastics tooling materials. Plastics provide an important means for reducing manufacturing costs in job-shop operations.

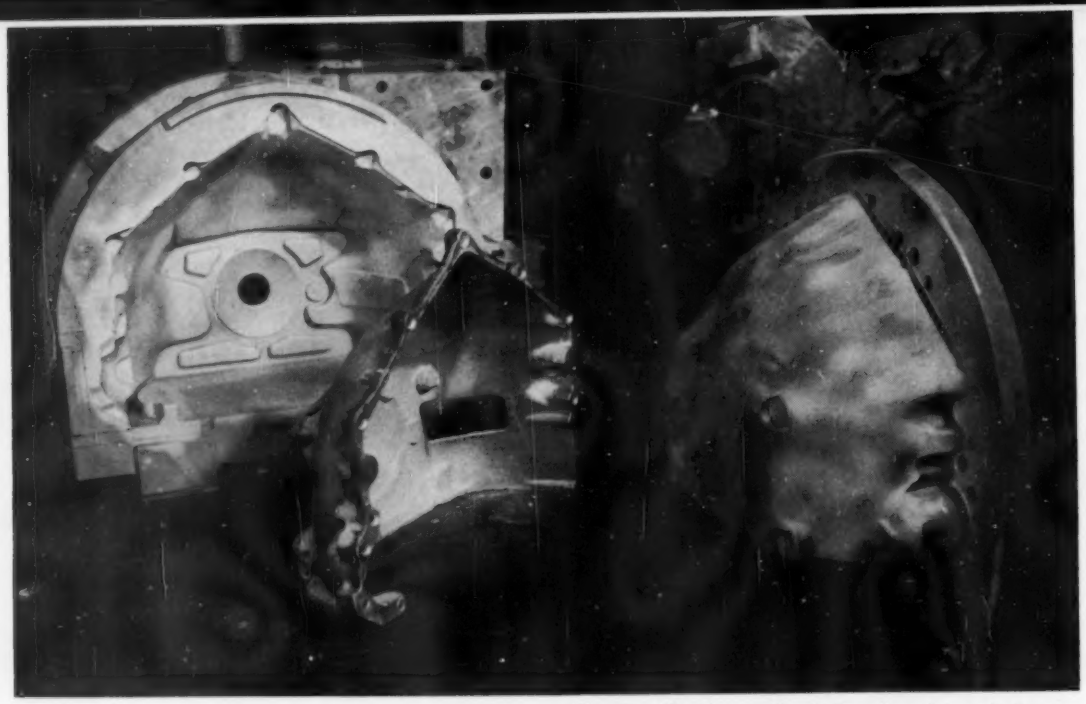


Fig. 1. Aluminum clutch housing (center) is produced from cast-to-size steel molds (left and right).

cast-to-size STEEL MOLDS cut compact car costs

A new low-pressure aluminum casting process and cast-to-size steel molds are giving outstanding results in the production of compact car engine components.

WITH THE ADVENT of compact cars, manufacturing engineers in the automotive industry have had an opportunity to apply new materials and methods in engine production. The Chevrolet Corvair, with its aluminum engine, is a case in point. Traditionally, engine castings are of iron and are produced by sand casting techniques. At the Chevrolet Motor Div., Massena, N. Y., engine castings are of aluminum, *Fig.* 1, and conventional sand-casting methods have been replaced by a new low-pressure permanent molding process.

The Massena plant is located less than a mile from the Reynolds Metal Co. plant where the aluminum is produced. Aluminum alloy (365) is delivered to the foundry on shuttle trucks carrying two 9000-lb ladles. It is at a temperature of 1600 F on arrival. Sixteen 30,000-lb-capacity holding furnaces in the foundry keep the molten metal at the proper temperature. When necessary, further alloying is accomplished in the holding furnaces. The objective is to produce an alloy with good castability and high mechanical properties. Fork type ladle trucks deliver the alloyed metal to the molding stations as needed.

A molding machine for crankcases is shown in *Fig.* 2. The mold set, which is hydraulically opened and closed, is on top of a 750-lb induction furnace. A pressure of 4 to 6 psi is sufficient to feed molten aluminum into the bottom of the mold during casting. Each machine is equipped with molds to produce left-hand or right-hand crankcase halves. Pouring—actually injection—temperature is somewhat higher than that normally used in the permanent mold process. The molds themselves are at 800-850 F. The actual molding cycle time depends

on a great number of variables—metal analysis and temperature, pressure, solidification time, mold temperature and "open-mold" time.

Originally, iron was used as a mold material. European automotive plants (where permanent-mold casting of engine components has been an accomplished fact for several years) have found that iron molds give satisfactory results. With the usual American desire for higher efficiency, however, Chevrolet ran its molds at higher temperatures and with shorter cycle times than is considered practicable in Europe. These operating conditions proved to be too severe for the iron molds. They cracked and eroded to such an extent that mold downtime and maintenance time became excessive. A better material was required.

Because of its excellent performance on other severe applications, such as die casting, H-13 die steel was tried out. The major mold components were produced in cast-to-size form by American Brake Shoe's Engineered Castings Div. Cast H-13 has excellent properties, with a tensile strength around 100,000 psi and 15 percent elongation in the annealed condition. These properties can be raised considerably, incidentally, by high-purity melting. Under a current research program for the Air Force, high-purity H-13 castings have been produced with 250,000-psi tensile strength, 190,000-psi yield strength and 10 percent elongation. This development may make cast H-13 suitable for die-casting dies, forging dies, extrusion dies and other tooling for which only wrought materials have been suitable up to the present.

The cast-to-size mold castings for Corvair engine production are normally annealed to a 225 Brinell hardness. A few light machining operations clean up any excessive stock that may be left on the sides, backs, mating faces and bosses of the molds. The backs of the molds are contoured and lightened in the casting process to save metal, eliminate machining and provide cooling. No Kellering is required and only a minimum amount of handworking is required on the mold contours.

After machining, mold details are hardened to R_C 55 by heating to 1850 F and air cooling. When an intermediate hardness is desirable, the mold material can be drawn back to R_C 40. To give added surface hardness, the molds can be nitrided.

Before operation, the molds are coated with a refractory material that protects the surface and aids in release. The refractory material also provides insulation; thus casting solidification can be controlled by varying the thickness of the coating. The coating may have to be touched up several times per shift.

Successful operation of the first cast-to-size steel mold sets led to their use on all 18 molding stations on the crankcase line. Other cast H-13 mold sets

Fig. 2. Cast aluminum crankcase half immediately after molding at Chevrolet Motor Div.

are used for permanent mold production of Corvair rear engine housings and clutch housings.

When large numbers of molds are used, the initial cost of cast-to-size steel molds is lower than for conventional machined molds. Patterns for cast-to-size molds cost about the same as Keller models. The cost of the castings plus simple machining of faces is less than the cost of a wrought billet plus Kellering time and the cost of waste metal. An additional benefit is utilization of the dense material that always is found in proximity to the as-cast surface. Engineering changes are no more difficult with cast-to-size molds than with machined molds. With proper scheduling, the total tooling time can be reduced 20 percent with cast-to-size molds—an important advantage in automotive production.

automated accuracy
—made possible by precision fixtures

By Walter R. Opel
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Precision fixturing is the key to the accuracy of modern transfer machines. The author, a pioneer in the field of automation, shows how accuracy requirements were met in the design of a complex milling, boring and reaming machine.

ACHIEVING high production rates and high precision in an automatic transfer machine is easy—after the machine has been built. Designing and building a machine that combines these characteristics is another matter. The machine shown in *Fig.* 1 produces transmission cases for a small European car. It is designed for a production rate of 140 parts per hour. Workpiece specifications call for maintaining hole size tolerances as small as ±0.00035 inch. Location tolerances for each hole in a group of three holes are ±0.001 inch with respect to each other hole in the group. These three holes are too close to each other to be bored in one station. Primary locating points are off, rather than on, the part.

Workpiece Requirements: The workpiece is delivered to the machine in the rough-machined state. All holes have been drilled and the ends have been rough-milled. The cover face has been finished milled. In the machine, the ends are finish milled, eight holes are semifinish and finish bored, and two holes are reamed, *Fig.* 2. All hole-finishing operations are performed perpendicular to the ends of the workpiece, which eliminates the need for turntables or other devices between successive machining operations.

Not all hole tolerances are as tight as those previously mentioned. The "loosest" hole tolerance is ±0.0005 inch. The over-all length dimension—established by milling from both sides of the line in the same station—carries a tolerance of ±0.0039 inch. These are part tolerances and they include all machining and manufacturing allowances. Finishes of 56-110 microinches are required.

Machine Design: The general configuration of this transfer machine is a rectangle, 30 x 40 feet, with the load-unload station and four machining stations comprising one of the longer legs. Pallet fixtures are moved through the machining stations on a lift-and-carry transfer bar. They are transported over the other three legs of the machine by chain conveyors that slide them on special skid rails that have no effect on accuracy.

Machine bases that combine center and wing units are used. This assures alignment within each station. Each base is mounted on a separate foundation so vibrations will not be transmitted between stations. Alignment between stations is achieved by individual adjustments for each of the base units.

Pallet Fixtures: Accuracy of the machine is the result of its inherent rigidity, the use of individually adjustable tools and spindles, and precise location and clamping of the workpieces in the machining stations. The transmission cases are located and securely clamped on the pallet fixtures, which in turn are accurately located and securely clamped in the machining stations.

Two cases are held in each pallet fixture, *Fig.* 3. Each part is held down by three spring-loaded clamps that apply their clamping forces directly through the flange to three rest spots. Spring-actuated locating pins engage locating holes in two lugs—which are removed before the part is used—on the top of the workpiece. Parts are located longitudinally against stops.

At the load station, the pallet fixture is held down by twin bars that are pushed across piloted slots at the top of the pallet. A clamp-release unit is

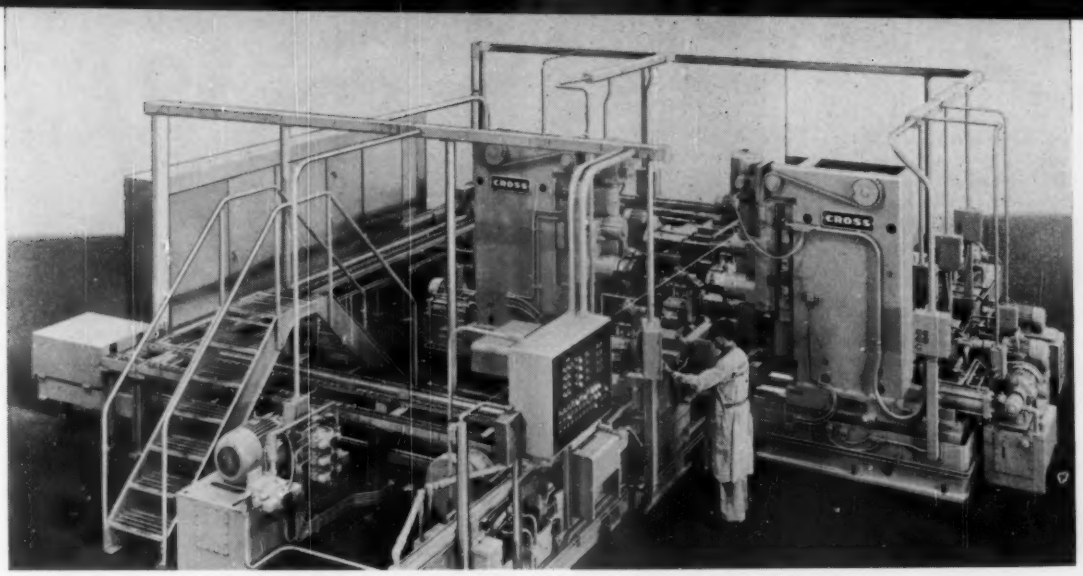

Fig. 1. Transfer machine for milling, boring and reaming transmission cases. Load-unload station is just to right of operator.

then hydraulically fed upward from beneath the pallet.

Buttons—in groups of three around each clamp rotator—contact the spring-retaining collars at the bottoms of the three clamps. When the clamp-release unit reaches its maximum upward travel, the clamps ars raised above the part flange. At this time, clamp rotators are engaged with the clamp tangs and rotate the clamps 120 deg to clear the part flange. Simultaneously, a rod is extended upward to disengage the locating pins.

With clamps and locating pins withdrawn, the operator manually removes the two finished workpieces and inserts two rough-machine castings. The parts are then automatically located and clamped.

Because the pallet fixtures are one of the major keys to the accuracy of this transfer machine, a spare has been provided. Also, a master fixture was prepared to check machine alignment and spindle location. It is run through the machine just as if it were a regular pallet fixture and spindle positions are checked against it. Individual cutting tools are checked and set before they are mounted on the spindles so the master fixture is not used to check hole sizes.

Location, Clamping: With a workpiece accurately clamped in the pallet fixture, the next requirement is for proper positioning of the pallets in the machining stations, *Fig.* 4. Pallets are lifted by the transfer bar and deposited in approximately the correct position. They rest on six locator buttons, ground at assembly to establish a horizontal plane in each station. Air is blown through these buttons during each transfer to dislodge chips.

Precise location of each pallet fixture is achieved by the several actions of a one-sided wedge powered by a hydraulic cylinder. This cylinder also provides the clamping force. The one-sided wedge pushes—at an angle of 60 deg to the vertical—into a slot on the pallet. The shape of the wedge causes the pallet to move forward the slight amount needed for accurate longitudinal location.

The straight side of the wedge at each machining station is the longitudinal reference surface for that station. As the pallet is moved into its correct longitudinal position, this surface contacts Surface "X" on the pallet. Surface "X" is the reference plane for all longitudinal dimensions on the pallet fixture. It is a replaceable hardened steel block that is fastened into and becomes the straight side of the slot in each pallet. These blocks are accurately ground so the hole patterns in the workpieces are precisely located in all machining stations.

As the wedge moves the pallet into its correct longitudinal position, it also pushes the pallet transversely against two fixed, inclined locator buttons. These buttons match locating surfaces on the pallets. Because the wedge and the locating buttons are inclined, the pallet is wedged downward and clamped securely in position.

Air signals give a positive indication that the pallet is correctly located and clamped. Passages carrying compressed air lead to orifices in both the

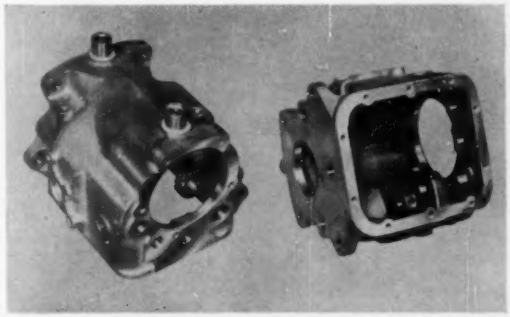

Fig. 2. Finish-machined transmission cases. Both end faces are milled and all major holes in both ends are finished in the transfer machine.

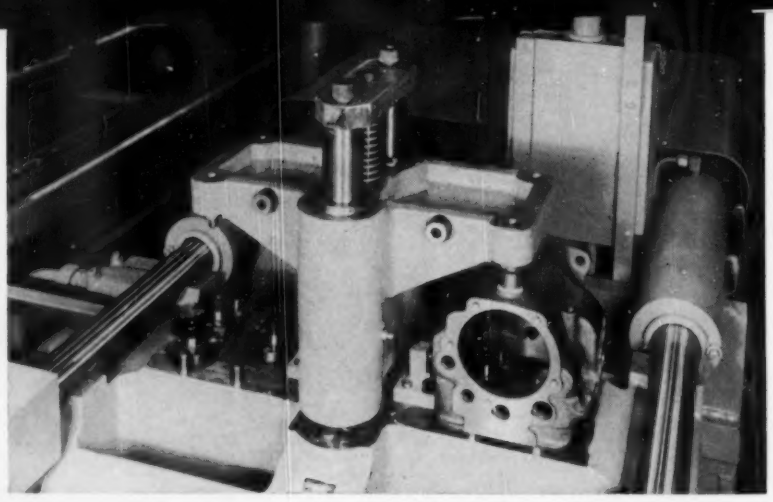

Fig. 3. (right) Clamps and locating pins are shown in the "clamped" position in this view of the pallet fixture at the loading station. Only one part has been clamped here.

Fig. 4. Pallet fixture in first boring station. The boring bars are advanced through the transmission case to finish the large holes on both ends. The inclined wedge and clamping device is to the right.

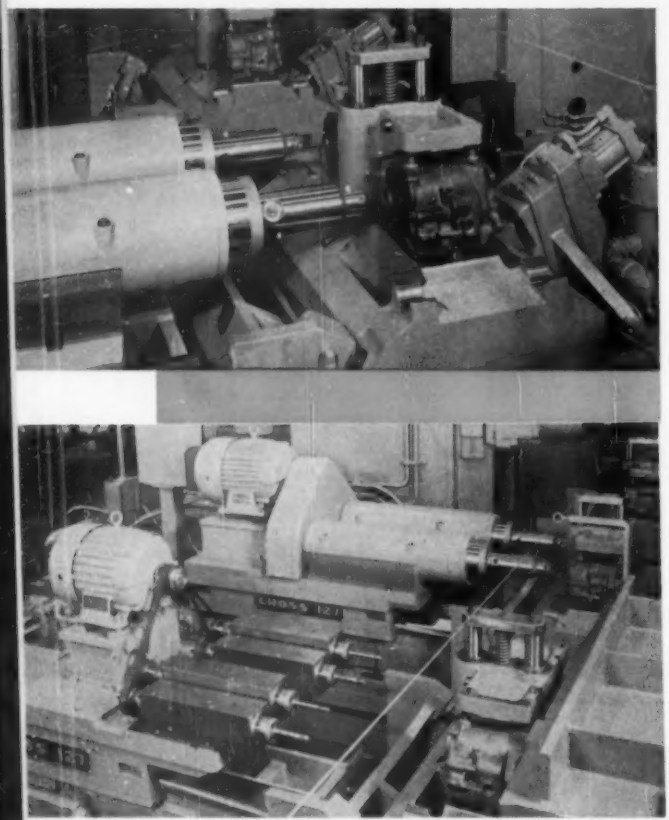

Fig. 5. Multiple spindles are rotated at correct speeds by using timing belts, different-sized pulleys.

straight and inclined faces of the wedge, and the locating faces of the two transverse locator buttons. All of these orifices are open to the atmosphere.

In a machining station, the pallet will close off all of these orifices if it is correctly positioned and clamped. Pressure build-up in the air lines activates an air-operated limit switch and initiates the machining cycle. Because of space limitations, another air line is used to signal when the wedge is fully withdrawn so the transfer cycle can start.

Because of the inclined locator buttons, transfer bar operation on this machine is somewhat unusual. The transfer bar, which is guided transversely by cam followers, rises slowly to its top position, which moves the pallets slightly to the left in the maching stations. The lift arms move beyond their high points to slightly lower the bar. This provides clearance between the locator buttons and their matching surfaces on the pallets, and protects them from damage or wear.

Hole-Finishing: Each of the precision boring spindles, *Fig.* 5, is separately mounted and is consequently adjustable in any direction. Hydraulically actuated V-way feed units are used. Because the three holes whose locations are tied together by center tolerances of ±0.001 inch are too close together to be finished by clustered spindles, each is finished in a different station. This is possible because pallets are located within much closer tolerances than those for the hole locations and because each spindle is individually adjustable.

One group of four spindles, mounted on a single feed unit, is operated by one electric motor. Because of the different diameters of holes they bore, two spindles rotate at one speed and the other two rotate at another speed. This results in correct surface cutting speeds for all cutters.

This has been accomplished by using different timing belts to turn each pair of spindles and by using different sizes of pulleys, *Fig.* 5. Vertical movement of the motor can be used to achieve correct tightness in one of the belts but an extra, adjustable idler is positioned on the motor mount to provide take-up for the second belt.

Boring bars are of a solid, heavy metal to minimize vibrations and each bit is mounted in a separate microadjustable cartridge. Some of the bars have four bits for semifinish and finish cuts in two different holes.

This machine demonstrates how fast automatic operation can be combined with high precision. The key to precision is good fixturing that enables the quality capabilities of the machine to be fully exploited in production.

turning HARDENED TOOL STEELS —with ceramic tools

By Fenton L. Bagley, Jr.
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Tools designed with large negative rakes can cut extremely hard materials at high speeds. This special geometry minimizes initial breakdown and strengthens the cutting edge, giving good life.

BECAUSE OF THEIR HARDNESS and refractory characteristics, ceramic cutting tools should be ideal for machining hardened materials at high speeds. Until recently, however, ceramic tools have not held up under these conditions. Experiments at Rodman Laboratory have shown that the tool geometry, rather than the tool material, accounts for some of the difficulties. A revised tool geometry, developed during the course of machining tests, now makes it possible to more fully exploit the production potential of ceramics when machining hardened tool steels.

The workpiece material used for the tests was a Type 5 manganese tool steel, air hardening and nondeforming. Its composition was 0.73 percent C, 2.47 percent Mn, 0.32 percent Si, 0.11 percent S, 0.037 percent P, 1.00 percent Cr, 0.12 percent V and 1.27 percent Mo. Steel at two hardness levels—50 and 61 R_C—was machined during the tests.

It was noticed during preliminary testing that the ceramic tools broke down rapidly during the first few seconds of a cut, developing wear areas that produced large negative effective rakes. If a tool survived this stage, it continued to cut with little further chipping. In one case, the performance of a tool improved considerably after a large section broke away, giving it a large negative rake. When this tool was inspected after 28 minutes of continuous cutting, there were no indications that the end of its useful life had been reached. Although the tool was badly chipped, *Fig.* 1, the surface finish it produced was still good. This made it even more certain that the optimum tool geometry for cutting hard materials with ceramics would include a highly negative effective rake.

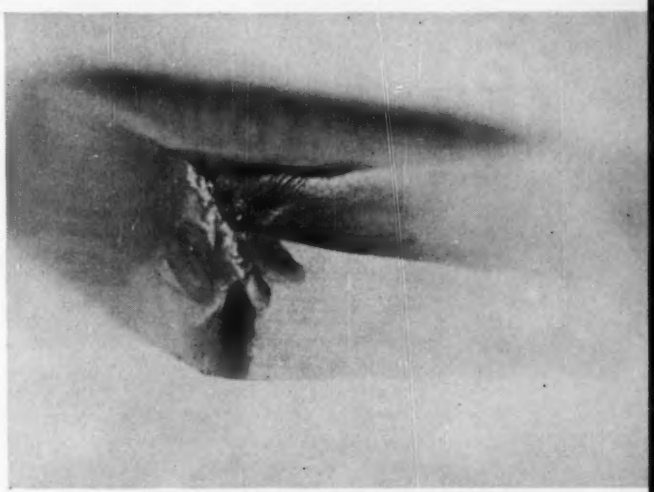

Fig. 1. Although a large piece of this ceramic tool broke off, it cut satisfactorily, indicating that tools with large negative rakes should stand up well when machining hardened tool steels.

The wear areas of the tools of normal geometry were measured to gather insight into the chip flow pattern and to provide a better basis for further development. The worn areas of these tools had an inclination angle (i) of 45 deg. Also, an effective rank (α_e) of 50 deg had resulted from cutting. Using this information as a starting point, the normal rank (α_n) was calculated. The effective rake is given by:

$$\sin \alpha_e = \sin^2 i + \cos^2 i \sin \alpha_n$$

Solving this for the normal rake:

$$\sin \alpha_n = \frac{\sin \alpha_e - \sin^2 i}{\cos^2 i}$$

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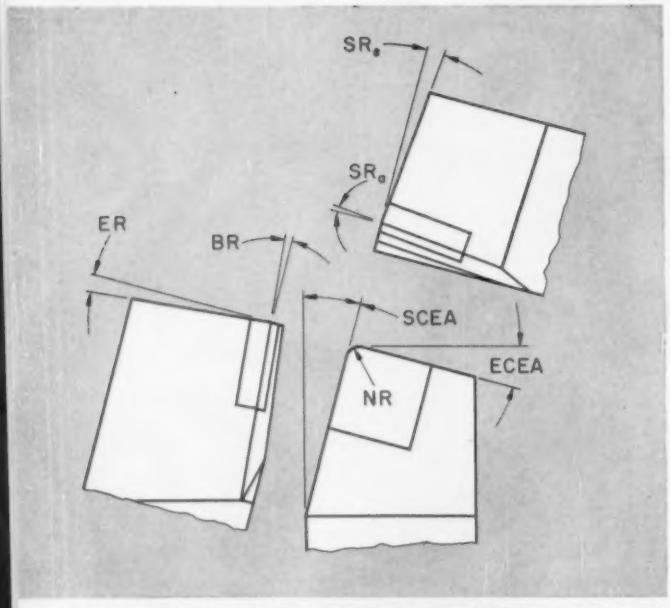


Fig. 2. Standard insert type toolholder used in cutting tests. Tool geometry is as follows: back rake (BR), −5 deg; side rake (SR$_a$), −5 deg; end relief (ER), +5 deg; side relief (SR$_s$), +5 deg; end cutting edge angle (ECEA), +15 deg; side cutting edge angle (SCEA), +15 deg; nose radius (NR), 1/16th inch. Tool material is aluminum oxide.

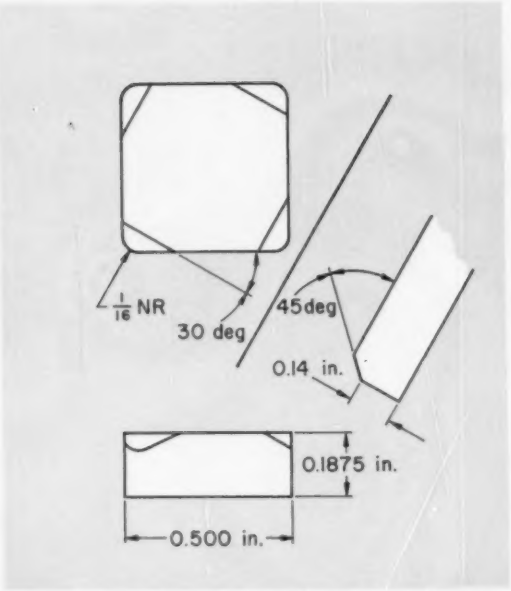


Fig. 3. Specially ground ceramic insert developed to machine tool steel hardened to R$_C$ 60.

These relations are based upon Stabler's Rule, which assumes that there is no change in width as the metal crosses the cutting edge.

From the computations it was estimated that the normal rake angle should be 32.2 deg. Since this was only a first approximation of the optimum conditions, a range of angles around this value was investigated. Using the basic geometry of the standard insert type toolholder shown in *Fig.* 2 it was found that the simple geometry change to a high negative rake angle, *Fig.* 3, gave excellent results. The tool shown in *Fig.* 4, designed with a high negative rake, was still producing a good surface finish after 52 minutes of continuous cutting at 400 fpm, with a 0.005-ipr feed and 0.030 depth of cut. The workpiece material was 62 R$_C$ tool steel.

The chips produced under these conditions are small and fragile. Care must be taken to provide protection for the machinist when cutting at speeds above 400 fpm, due to the spray of molten particles and red-hot chips produced by the high temperatures and pressures at the tool-chip interface.

The principal advantage of the large-negative-rake geometry is that it minimizes the initial breakdown of the tool, thereby reducing the variation of the finished diameter caused by chipping. Another advantage is that if the tool does fail by cracking, the cutting edge is so strong that the tool will continue to cut for some time after breaking, giving the operator sufficient time to stop the lathe. This strength margin should prevent any damage to the

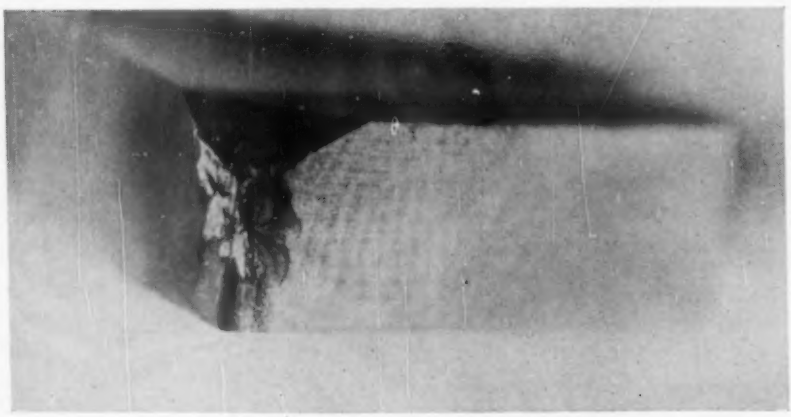


Fig. 4. Condition of a negative-r a k e ceramic tool after 52 minutes of cutting a R$_C$ 62 steel.

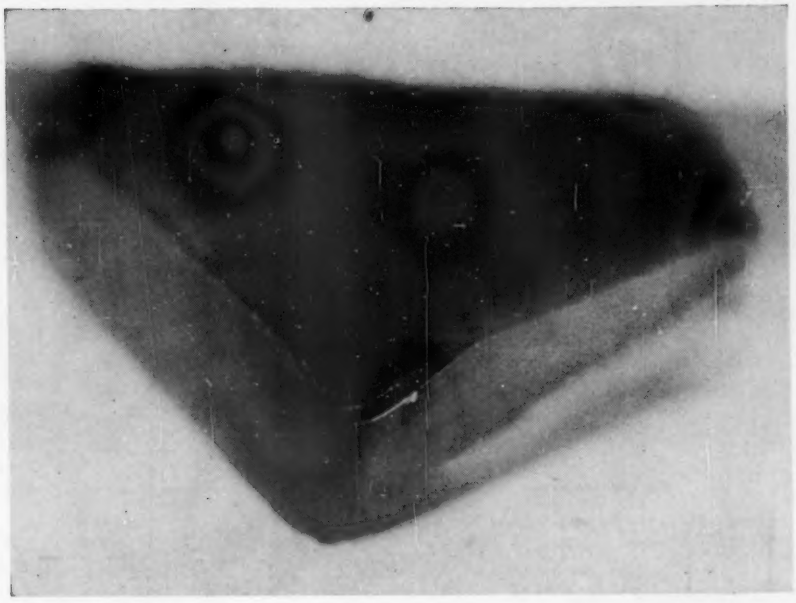


Fig. 5. Condition of a negative-rake ceramic tool after 17 minutes of cutting. The workpiece was hardened to R_C 50.

toolholder from sudden failures in service.

Due to the high strength of the cutting edge, tool life is mainly dependent upon the required tolerances and the rigidity of the lathes being used. During testing some tools developed feed and radial forces of over 1000 lb without causing tool breakage. An appreciable taper will be produced under these conditions, unless the workpiece and the lathe are rigid. The increased strength of the cutting edge also makes the tool much more resistant to impact during initial contact and in intermittent cutting.

The only disadvantage of large negative effective rake angles is that they increase cutting forces. These high forces preclude the use of this geometry when turning thin-wall tubing and small diameters. Horsepower consumption is also slightly increased, but not to an extent that causes difficulty.

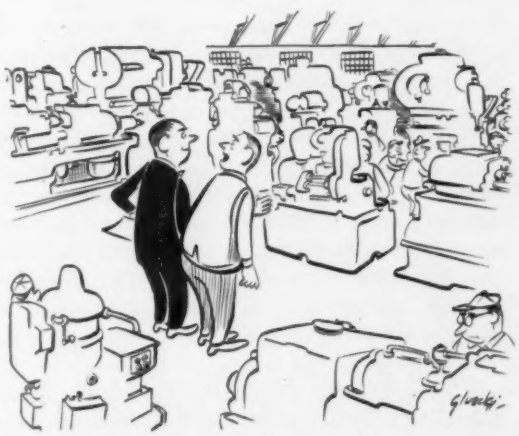
Because of the strength of the cutting edge and the refractory nature of the ceramic, ceramic tools with large negative rakes are excellent for the turning of high-hardness materials at high cutting speeds (>300fpm). The tests showed that large negative rakes are not suitable for use at high feeds. The optimum feed for the material tested was 0.005 ipr. At higher feeds the compressive strength of the ceramic was exceeded at the moment of entry into the cut and the tool was crushed, destroying the cutting surface.

The depth of cut is not as critical. A depth of cut of 0.080 inch was successfully achieved at 0.005 ipr and 1000 fpm. Deeper cuts could probably be taken at lower cutting speeds.

Another possible application of this large-negative-rake tool is turning softer materials at very high speeds. *Fig.* 5 shows a tool after machining 52 R_C tool steel continuously for 17 minutes at a speed of 1000 fpm, a 0.005-ipr feed, and a 0.060-inch depth of cut. The wear land of a normal insert, cutting under the same conditions for the same length of time was nearly 0.001 inch greater than that on the large-negative-rake tool.

The optimum effective rake angle is determined by the strength of the workpiece material, so the specific angles given here should be used as a starting point and then varied to achieve the optimum for a specific application.

The geometry described may lead to successful milling with ceramic tools. As yet, this application has not been investigated.



"We ought to start weeding out—before the machines choke off production . . ."

drawing in 3-dimensional space —displaying space and time dimensions

Objects and phenomena that exist in three-dimensional space have conventionally been shown in two dimensions because no other more adequate means existed. A significant breakthrough now supplies the missing dimension and enables drawing in three dimensions. Improved communication should result.

HANDICAPPED by lack of other means, engineers and scientists have had to be content with two-dimensional displays of ideas and data. Drawings made on flat two-dimensional pieces of paper show the third dimension by using different views or by using perspective. The same is true of curves and data plots involving three variables. The inadequacy of a two-dimensional idea presentation is indicated by the value of a three-dimensional plant layout—though expensive, it permits better visualization of plant process and work flow, and usually saves many times what it costs. But scaled models are unsuitable for presenting many three-dimensional phenomena—the path of a missile, for instance, or the successive positions of a cutter as it removes metal from a workpiece. The need for three-dimensional display is often expressed in the gestures engineers make with their hands as they describe these phenomena. Such limitations to the presentation and visualization of data and ideas are overcome by a new data display device that actually can draw lines in three dimensions.

Three-Dimensional Data Display: To draw a line in three-dimensional space, as shown in *Fig.* 1, the system suspends an ink trace in a transparent gel. The line exists in three dimensions; it is not an illusional perspective representation of three dimensions. Moving a pen or stylus through this medium while depositing ink that remains suspended is feasible only because of the behavior of the gel. It has a semisolid consistency when undisturbed, but flows easily under stress. Thus, although the stylus can move readily through the gel, ejecting ink as it moves, the ink trace remains firmly suspended. The trace is relatively stable because its specific gravity is very close to that of the gel. It does not shift appreciably under normal handling conditions and lasts from six months to a year. The trace can be retained by using a thermosetting gel. Different types and colors of ink, permanent and disappearing, can be used.

The gel case is clear; the gel is transparent, so that after a trace is made it remains as though poised in mid-air. The engineer can walk around his plot and inspect it from many angles—or if the shape of a physical object is displayed from original engineering data, the object appears in three full dimensions and can be viewed from a full 360 degrees. By walking around it, visualization is complete as if a scale model were made.

Three-dimensional drawing or plotting can be accomplished in several ways, the simplest being to steer the stylus through the gel by hand-holding it. This sort of three-dimensional freehand drawing is rarely used, however, except for erasing a trace. In erasing, a suction tube replaces the stylus and is either hand-guided or automatically guided to follow the path of whatever trace is in the gel, effectively erasing it by removing it. More often, the three servo drives visible above the gel tank in *Fig.* 2 are used to direct the stylus path through the gel. These three independent servo systems transmit torque to the stylus via a ball-bearing leadscrew on each axis. Maximum speed along any axis is

Fig. 1. Plotted in three dimensions as it occurs, a missile's behavior can be realistically understood by engineers since the trace can be viewed from all sides.

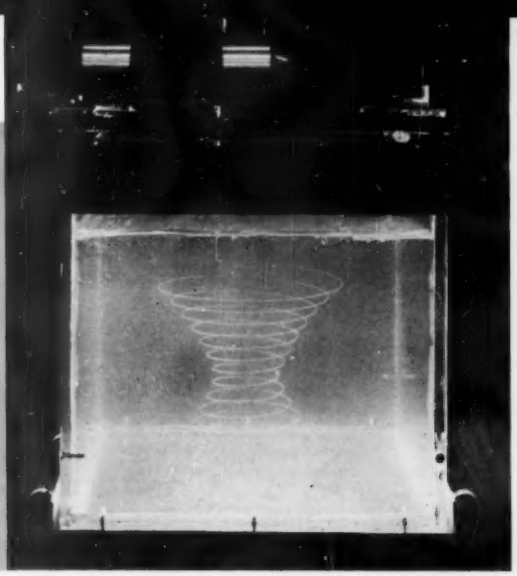


Fig. 2. Ink traces in three dimensions show flight patterns in space, using a three-dimensional plotter developed by the Missile Div. of Chrysler Corp.

60 ipm, so that the vector sum of three-axis movement is a little more than 100 ipm. A system with 600-ipm axis speed is being developed. Input to the servos can be from some data source or program such as a computer, or manual, using push-button and potentiometer controls. For example, information from a tabulated sheet or punched cards can be presented by manually positioning the stylus and marking each point, repeating the process until the complete line or surface is generated.

To operate automatically, analog information can be plotted directly from an analog computer. The helix shown in *Fig.* 2 was produced by this means. Information regarding a missile's characteristics was given to the computer and the missile behavior during trajectory was computed and displayed. Realtime presentation of performance can also be achieved with the plotter, for example using inputs from missile trackers or wind tunnel sensors. Scaling of data to fit tank size is done with simple circuits, or the tank can be built larger to accommodate large-scale inputs. While any performance plot is being made, the fourth dimension, time, can be injected into the display by pulsing ink delivery at discrete and known time intervals. At completion, the plot shows the behavior of three variables and their time relation.

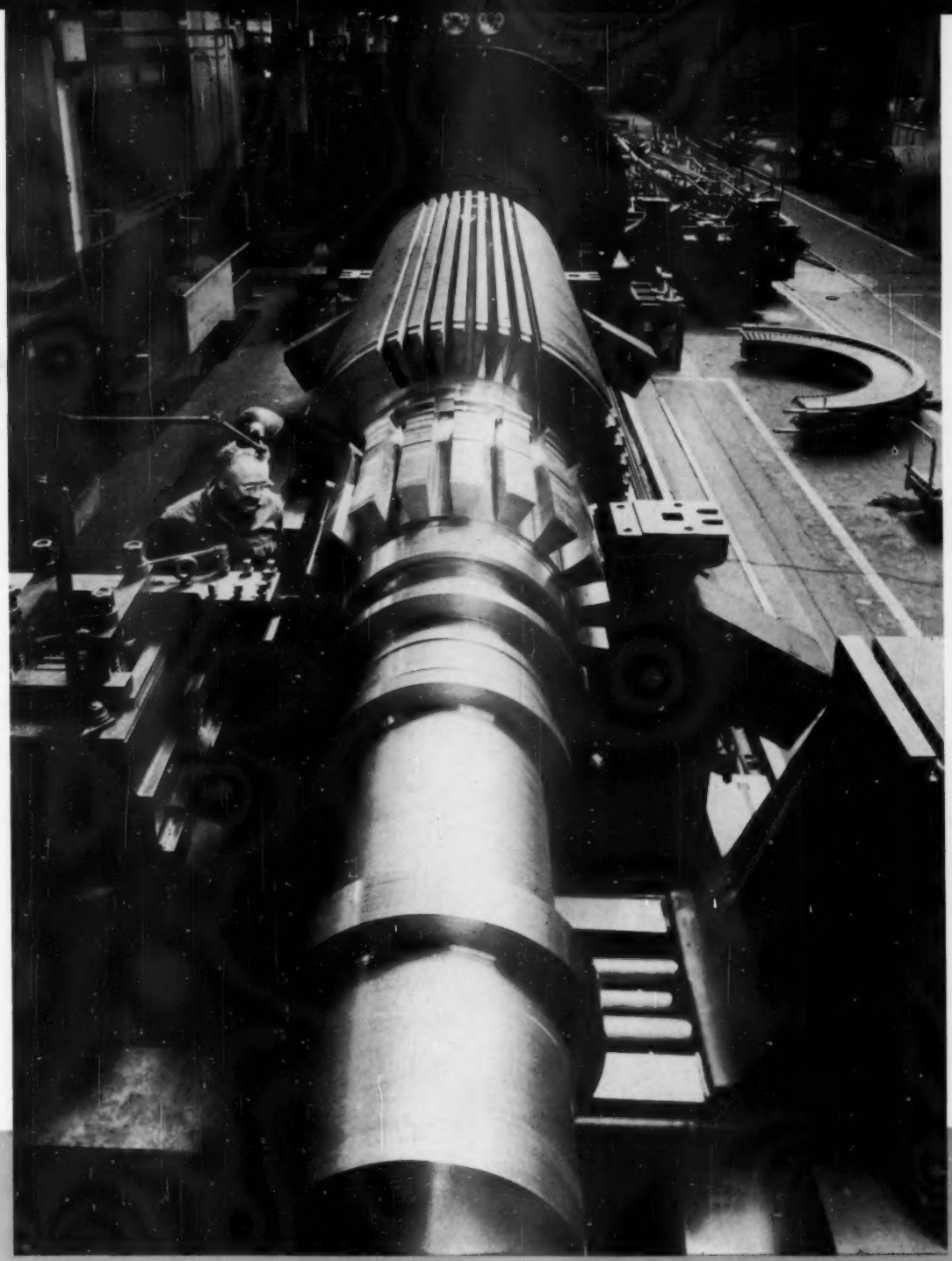
Amplified appropriately to drive the servos, digital computer outputs of three variables and time can be used. Of greatest interest to tool and manufacturing engineers are the possibilities of (1) displaying three-dimensional appearance of any designed piece before manufacturing planning begins, and (2) displaying planned cutter paths in numerical control work. For the same reasons that three-dimensional plant layouts enable engineers to visualize q u i c k l y how a facility will operate, the three-dimensional display of designs made by computers facilitates visualization and thus enables manufacturing engineers to achieve planning efficiencies that are otherwise impossible. For one of the main difficulties that engineers encounter with computers is the display of computer solutions. Much of the value of the computer's high-powered b r a i n is wasted unless it can display intelligibly what it has done. Though the pages and pages of computer-printed data may be accurate, they are not really digestible. This shortcoming in the computerized process of translating ideas into realities is largely overcome by three-dimensional displays. When computers are used to assist design, the information about product size and shape is available in the computer and wants only to be presented. A good idea of what the workpiece really looks like can aid considerably in planning the fixturing, machining and handling for its production.

When numerical control is used to machine a workpiece, complete information regarding the cutter path is contained in the computer. To dump this already existing but abstract information into the display unit is a relatively easy task. The advantages of actually seeing a cutter path as it develops—as a test run prior to machining—are apparent. Clamping, holding and fixturing that will be used can be drawn on the side of the gel tank to determine whether the cutter will strike any of these. Errors in planning or computing are made discernible prior to actual metal removal. Time-pulsing the ink trace indicates visually the rate of cutter movement to help determine whether cutting proceeds at an optimum speed.

Thus, an important limitation to effective communication has been removed. Three-dimensional presentation enables humans to work more efficiently by providing a more adequate representation of objects and ideas in space and time.

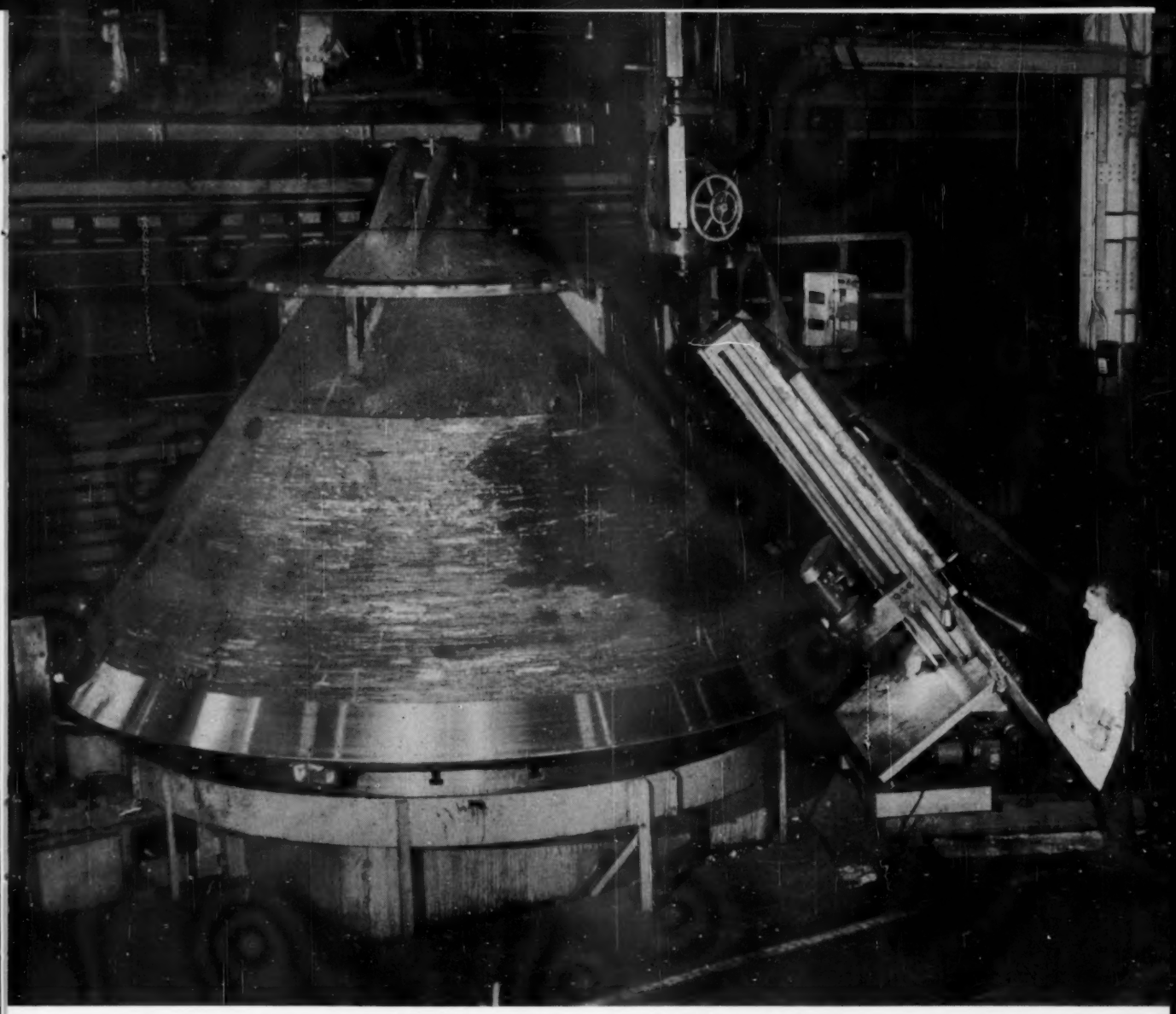
TOOLS at work

SHOWN BEING MACHINED under tracer control is a 14-ton die for forging T-39 Sabreliner wing spars. This top half of the die is 14 inches thick, 26 inches wide and 272 inches long. Some 45 different cutters, each resharpened five times, are used in machining the die. Tolerances of ±0.010 inch are maintained in the cavities. Surface finish is approximately 32 microinches. Installed in a 50,000-ton press at Alcoa's Cleveland works, the die produces 23-foot-long, 320-lb forgings (inset) from a billet of 7079 alloy.



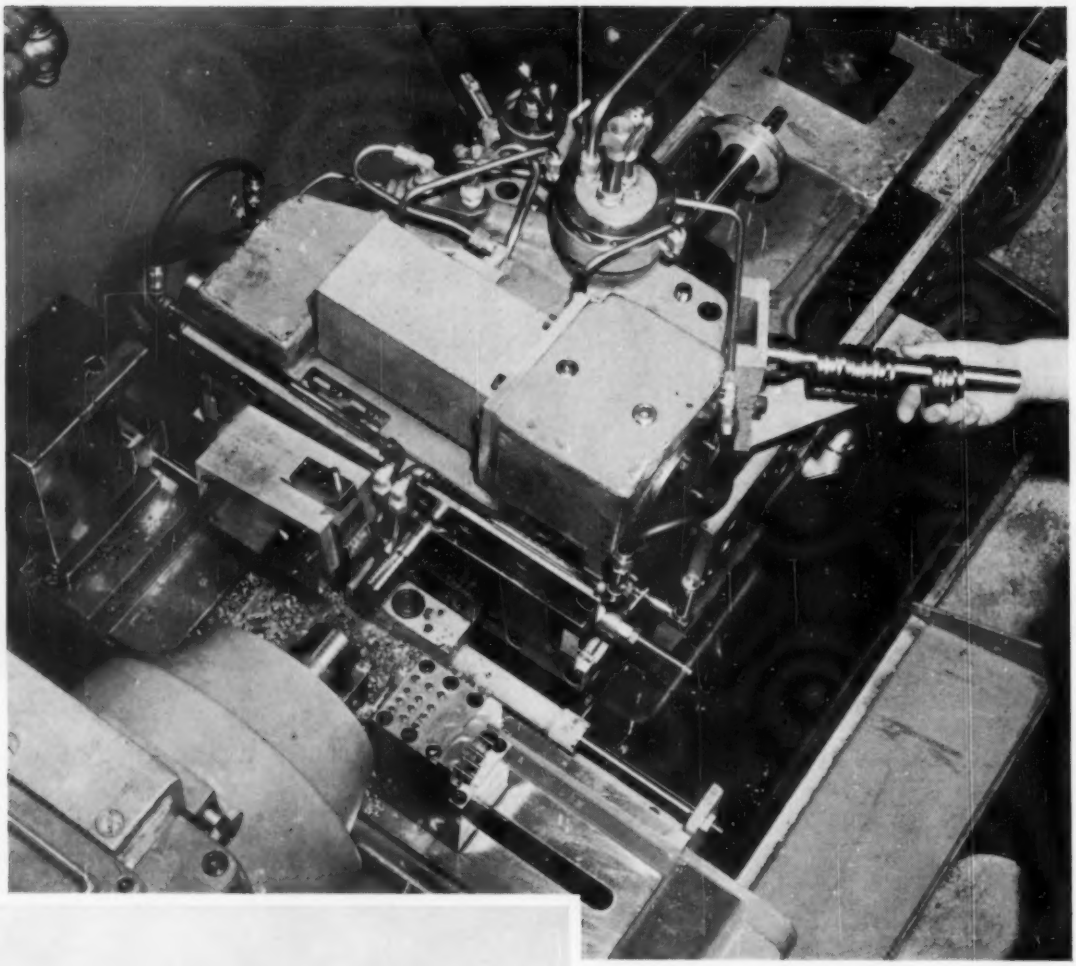
APPROXIMATELY 46,000 lb of chips were removed during the machining of this rotor for a steam turbine generator at Allis Chalmers Mfg. Co. Initial weight was 196,000 lb; final weight was 150,000 lb. The lathe is a Betts-Bridgeford geared head machine with 60 feet between centers. Carbide tools were used to rough turn the rotor at a speed of 180 fpm, a feed of 0.042 ipr, with up to one-half inch depth of stock removal. Semifinish and finish turning was performed with high-speed steel tooling at 30 to 50 fpm, with feed varying from 0.042 for single-point tools to 0.500 ipr for broad-nose tools. Final finishes (16 microinches for bearing surfaces) were obtained by mechanical abrasive polishing. Tolerances as small as +0.000, —0.002 inch are held. Shaft slots were machined on a large Ingersoll specially designed for rotor slotting. The slots were rough and finish milled using 30-inch diameter carbide blade cutters run at 300 fpm and 4 ipm feed. Wedge grooves were then milled in the slots with carbide tipped form end mills at 310 rpm with a feed of 4 ipm to complete the machining.

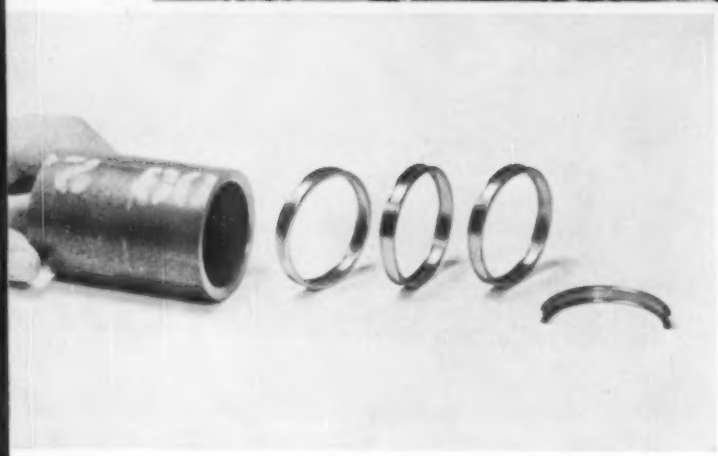
CUTTING HEAD (top center) uses carbide tools for rough turning a 30-ton hopper for a blast furnace at the Steelweld Div. of the R. C. Mahon Co. As part of a restoration process, the 8.5-foot high hopper is first rough turned, then hardsurfaced and final machined. Both rough and final machining are done on the same 24-foot boring mill, using the same head for rough machining and finish machining. The double-duty head is first mounted as a cutting head for roughing and then mounted with a grinding wheel for finish machining the hopper. The hopper mates to a large steel bell, shown right, when assembled for operation in the blast furnace.



DOUBLE-DUTY HEAD, mounted with a 14-inch grinding wheel is used to final machine a 33-ton steel bell after hardsurfacing. The head works upward toward the apex of the work automatically as the bell is rotated. Specially designed and built by Mahon engineers to work on a 53-deg taper, the head (mounted with a grinding wheel) was also used in finish machining the hopper to which the bell mates. Finishes of 8 microinches were obtained on the hardened seating areas. The close-tolerance finish on the mating diameters of the two blast furnace parts is required to assure a gas-tight fit when the restored hopper and bell are assembled for blast furnace operation.

TOOLS at work





THREE FINISHED spinning rings are produced in less than two minutes by this Gisholt ram type turret lathe which replaces a six-spindle machine at the Pawtucket Spinning Ring Co. Core of the operation is the simultaneous ID and OD forming (center) using two slides mounted at station 4 of the hexagonal turret (stations 3 and 5 provide support). The workpiece (inset photo) must be machined without distortion of the thin wall and must have a fine finish. The slide-mounted tools cut the ID and OD of three spinning rings simultaneously to avoid wall distortion. The turret then indexes to station 6 and presents the catch bar. Four stagger-mounted cutoff tools in the side carriage move in and the finished parts drop one at a time onto the catch bar. Finish obtained is 32 microinches. The previous operation required three roughing passes, a finishing cut and more tooling.

TOOLS at work

getting the most out of SHELL MOLDING

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Because of its inherent accuracy and adaptability to high-volume production, the shell-molding process may be the best choice when precision casting methods are being selected. The author compares shell molding with other precision processes, assesses its advantages and disadvantages and tells how manufacturing engineers can get the most—in terms of cost, quality and efficiency—out of the shell molding process.

ALTHOUGH SHELL MOLDING is an economical and versatile method of precision casting, industry has been slow to take advantage of its ability to cut costs and improve quality. One reason for this neglect is the unfortunate experience some foundries have had when they attempted to apply shell molding. Molding costs have been high and the potential accuracy that is possible with shell molding has not been realized. This is usually due to the difference between the way shell molding is done in some foundries and the way it ought to be done. Many of the foundries currently engaged in shell molding have neither the personnel nor the equipment to manufacture shell-molded castings on an efficient basis.

Foundry failures in this respect are due to several factors. These include: attempts to integrate shell molding into existing green-sand operations; the use of inferior equipment for making shell molds and cores; and the lack of personnel who are trained and experienced in shell-molding techniques. It should be pointed out that in companies that have had outstanding success in applying shell molding, the shell molding operations are completely divorced from conventional foundry operations.

Competitive Processes: There are a number of precision casting processes that give satisfactory results in production. Shell molding is comparable to most of these processes in accuracy and often offers significant advantages in cost and versatility, *Fig.* 1. A comparison between these processes appears in TABLE 1, which is based on the experience of a number of companies who have had broad experience with shell molding, as well as other precision casting processes.

Lost-wax investment casting is superior to shell molding in its ability to produce intricate castings. It is especially applicable to castings that require back draft or other details that prevent the straight withdrawal of a shell mold from its pattern. Another advantage of the lost-wax process is that its molds are inorganic and gas-formation problems are minimized. On the other hand, production and tooling costs are higher for lost-wax investment casting and lead time is longer.

Permanent molding, another competitive process, offers no significant advantages over shell molding and tooling costs are higher. Die casting provides lower production costs and allows for thinner sections when certain metals are cast. It also permits smaller holes to be cast but it is limited by its smaller range of acceptable metals.

Shell moldings are considered competitive, with precision forgings and certain weldments. However, if the multi-directional-strength qualities of a shell casting are fully utilized, forgings fail to offer

any advantages over castable shapes. Weldments offer only one advantage: the first sample can be produced in shorter time.

Machining costs must also be considered in making comparisons between shell molding and its competitive processes. Although new machining techniques, as exemplified by in-line and rotary-transfer machines, have done much to reduce labor costs, chip production is still expensive. Shell molding reduces costs by eliminating all rough machining operations. This, of course, does not eliminate maching, but it does reduce the magnitude of the metal-removal problem.

Green-Sand Casting: Green-sand castings are not included in TABLE 1 because they are not precision castings. Nevertheless, shell molding competes most extensively with the green-sand process. Shell molding is usually considered more expensive. Such comparisons, however are not necessarily valid. For example, shell molding as conducted by some companies is comparatively crude, although green-sand operations in the same companies are mechanized. In such plants shell molding suffers by comparison, but if the automation techniques it provides are utilized, it is actually less expensive than green-sand molding.

One of the more important economies provided by shell molding is reduced metal requirements. When modern shell-molding techniques are employed, the cost per mold is so small that an increase of metal yield of 10 percent (using 6¢ cupola iron) is generally more than enough to offset the entire cost of the shell-mold material. If the sand is reclaimed and re-used—a routine practice in green-sand molding, and one now possible in shell molding—the cost is lowered further.

The increase in metal yield in shell molds stems from several sources. For one, less metal in required in the gating system because of the dry, smooth and exothermic characteristics of the mold. Another factor of importance is the potentially greater number of castings permissible in a mold area. A third important factor is the decreased weight of shell-mold castings. Because they are closer to finished part dimensions than green-sand castings can possibly be made, substantial savings are effected in metal requirements as well as in machining time.

When these factors are evaluated—automation potential, decreased weight, reduced maching requirements—precision shell-molding castings cost the same or less than green-sand castings. (It should be noted that the reverse can be true. One progressive foundry has found that where mold size and flask flexibility make possible extra casting cavities, green sand is cheaper.)

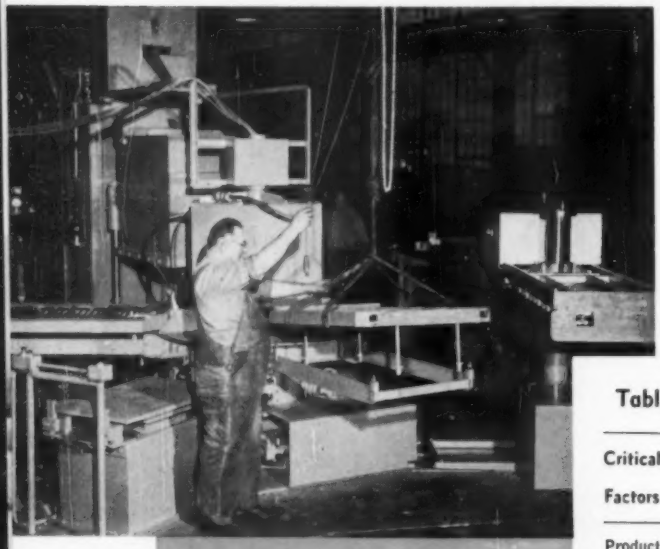

Fig. 1. Pattern-changing operation. Designed for fast changeover, this machine minimizes quantities required for economical production.

Table 1—Shell Molding Versus Other Precision Processes

Critical Factors	Lost Wax Investment Casting	Permanent Molding Process	Die Casting Process	Precision Forging Methods	Fabricated Weldments
Production cost	higher	comparable	lower	higher	higher
Tooling cost	higher	higher	higher	higher	higher
Tooling life	comparable	shorter	shorter	shorter	shorter
Accuracy	comparable	comparable	comparable	poorer	poorer
Surface finish	comparable	poorer	comparable	poorer	poorer
Intricacy of casting	higher	less	less	less	less
Part-to-part uniformity	comparable	poorer	poorer	poorer	poorer
Stress distribution	comparable	poorer	poorer	poorer	poorer
Capability to cast different metals	comparable	less	less	less	less
Lead time	longer	longer	longer	longer	shorter
Machining costs	comparable	higher	higher	higher	higher
Adaptability for large parts	poorer	poorer	poorer	poorer	poorer
Adaptability for small parts	poorer	poorer	faster	poorer	poorer

It might be argued that if green-sand molding were to be put on an automated basis similar to that used in shell casting, *Fig.* 2, the cost per casting would be below that for shell molding. This argument does not stand up when facilities costs are considered. In practice, an automated shell-mold line can be set up for a small fraction of the cost of a green-sand line. One reason for this is the weight and sand-volume difference: a shell mold weighs about 5 percent as much as a comparable green-sand mold.

Production Quantity Factors: When modern equipment which provides for quick pattern changing is used, the manufacturing quantity of shell castings in not a factor of great importance. For example, on the equipment shown in *Figs.* 1 and 2, a wide variety of shell molds can be produced simultaneously. This is being done in jobbing foundries that have short production runs on a wide variety of castings at the high rates of production normally associated with mass-production manufacturing.

This flexible high-speed operation can be employed with various metals simultanously on the same mold and casting production line. In such cases it is necessary to synchronize mold production with metal melting. This provides for further flexibility and versatility of the facility. The variables normally required in mold characteristics—thickness and degree of cure—are automatically and individually provided for in shell molding machines of the type shown.

Tooling: By far the preponderant cost factors relating to quantity of castings produced are the cost of patterns and core boxes. It is impossible to make castings with greater accuracy than the tooling from which the moldings and cores are made. In this respect conventional pattern shops fail when they attempt to make shell-mold tooling. The materials of shell tooling—primarily iron and steel—are types that few shops are equipped to cut or grind. In addition, the precise measurements required for such tooling are unattainable by conventional pattern-shop techniques. Some shops now enjoy success in this field, but their success stems from their use of tool and die making techniques.

Tooling for shell-mold castings consists of patterns and core boxes, properly called "thermodies." Closely resembling die-casting dies, thermodies, like other forms of precision tooling, should be made from dimensional drawings. As such, they can incorporate necessary shrinkage allowances and if they are to be successful, they must be built with tool and die precision. Shell molds and cores have their own peculiar expansion characteristics. These characteristics, combined with shrinkage factors, create conditions which are predictable but which cannot be resolved by standard shrink rules or rule of thumb.

Dimensioned drawings are also useful in establishing recorded bases from which dimensions can be checked. Without such a controlled and basic start, the thermodie builder has no way of checking and correcting dimensional allowances which may occur.

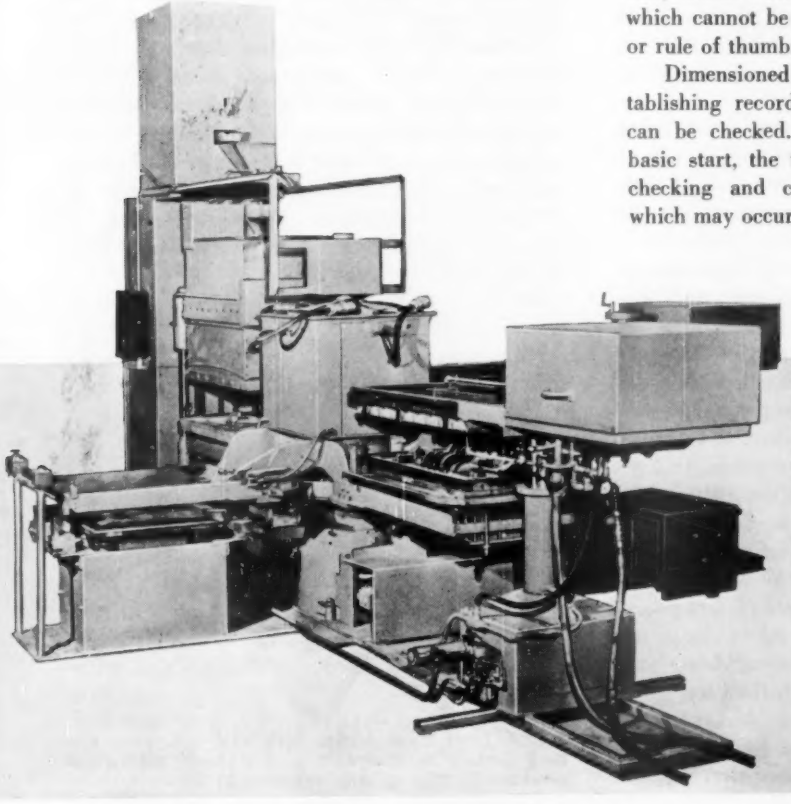

Fig. 2. Rotary index shell-molding machine. Machine can produce 120 parts per hour.

The fundamental construction of thermodies from relatively simple geometric shapes provides a basic key to low cost in shell-mold tooling. Such shapes, produced economically on toolroom equipment, minimize scrap loss and provide maximum flexibility for future maintenance or alterations. It is especially fortunate that most close-tolerance surfaces are designed either flat or as surfaces of rotation since these are surfaces most easily generated on toolroom equipment. When complicated contours are required, they can generally be produced in iron or steel by several precision-casting methods now available. These sections can then be fitted to others of simpler form to make a relatively inexpensive assembly.

No inference that shell mold patterns can be produced at costs comparable to those of aluminum match plates cast-to-size in plaster molds is intended. When shell-mold tooling costs are compared with green-sand mold "machine-equipment patterns," and core boxes with the multitude of core dryers required in green-sand casting, however, it is not uncommon for shell-mold tooling to be less expensive. The fact that shell cores are ready for the mold assembly when they are removed from the core box—without the use of dryers—is an important advantage.

Another important factor in shell molding is that in many cases cores can be eliminated entirely. The holes or cavities in the casting are produced by the mold. Because of its strength, the shell-mold material permits use of mold projections for such purposes—an impossibility in green-sand molding.

Tooling Cost: The tooling cost of producing a casting is only part of the total tooling cost of producing finished parts. Any comparison of tooling costs between two competitive methods of casting requires an evaluation of all tooling costs—not just the tooling costs involved in producing the castings. In spite of this, many comparisons between shell and green-sand castings are made on the basis of thermodies versus "patterns." The reason for this is usually purchasing practices. It is the responsibility of tool and manufacturing engineers to obtain the lowest over-all part cost at the minimum tooling cost consistent with required quality. Not infrequently the engineer's responsibility starts with the machining operations. The product design engineer specifies a casting and the purchasing agent buys the lowest-cost casting he can find that meets specifications. Pattern cost and casting prices are minimized and, as a result, total tooling costs increase. At no point is the reduced machining cost and lighter tooling provided by shell casting considered.

Another factor often overlooked by purchasing agents is the size and contour consistency characteristic of shell castings and the manner in which this consistency contributes to fixture simplicity and lower cost. On transfer-machine tooling, size and shape consistency is invaluable.

When all these factors are evaluated it is obvious that if the quantity required warrants the consideration of metal-pattern equipment, shell molding should be considered. The total tooling cost will probably be less than that for green-sand or any other process which competes with shell casting.

Casting Size: In the shell-molding process, as it was originally conceived, molds were supported or backed with steel shot. Even with this support the process was intended primarily for small and medium-sized castings. Despite this intended limitation, the Ford Motor Co. has been successful in producing automotive crankshafts weighing as much as 60 lb. Poured vertically, these shafts are cast two to a mold, with steel shot or contour clamp-plate backing. This job has remained in continuous and successful production since 1952.

In recent years the technique of adhesive bonding of two shell-mold halves with a powdered resin, has been developed. It has been said—not without some measure of truth—that this development has created the greatest setback to shell molding to date. While the practice has solved problems and reduced expense incidental to handling and cooling of steel shot, it also creates a number of new ones. In many cases the volume of metal poured into these "sand balloons" is excessive. As a consequence, much of the size capacity and accuracy of shell molding is lost. Another shell-molding technique utilizes extra-thick shells. This technique is only partially successful since it decreases productivity and requires an excessive amount of mold material.

There is no substitute for proper backing and adequate support for molds in shell molding. When

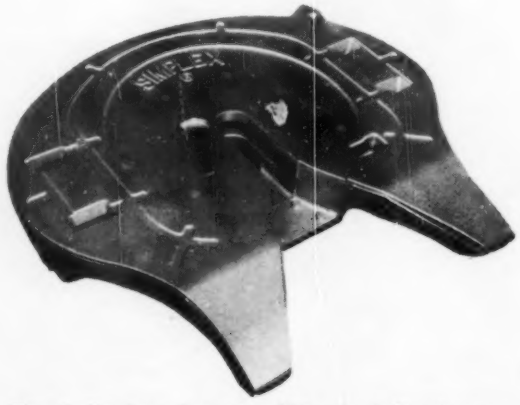

Fig. 3. Steel truck trailer fifth wheel. Bearing surface is cast to size and used without subsequent machining. This casting weighs 220 lb.

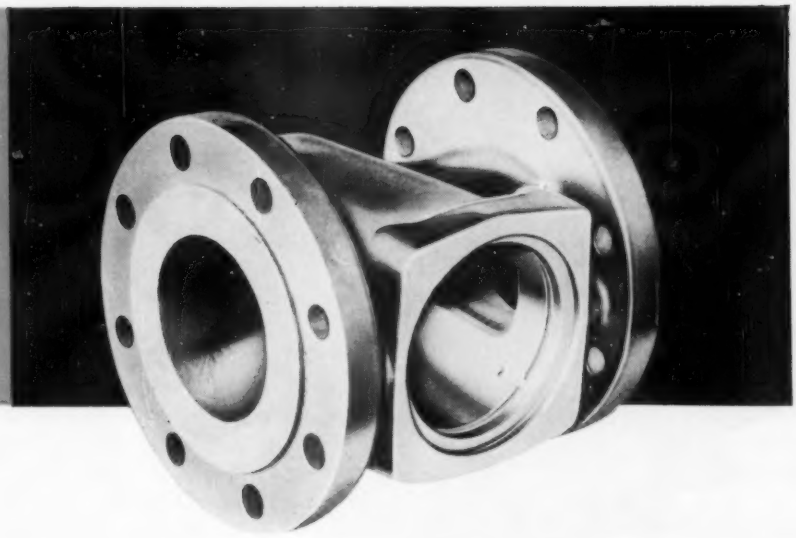

Fig. 4. Plug valve produced by shell molding. Weight savings of 11 lb (from 65 to 54 lb) resulted from changeover to the shell molding process.

castings are small or accuracy requirements are minimal, support may not be a problem, but in normal usage proper support is mandatory. The backing material need not be steel shot in all applications. Gravel and sand have been successfully used and zircon sand, with roughly double the weight of silica sand, has a number of advantages as a mold backup material. Adhesive bonding is useful in handling mold and core assemblies and can be beneficial in assisting the backup material.

When horizontal, rather than vertical pouring is used, proper support can be obtained by bedding the mold in shot or sand and covering it with the same material. Camshafts at the Ford Motor Co. are produced in this manner with steel shot utilized as bedding and blanketing. Another method of hold-down, in cases where sand is used as a cover, is with weights or clamps. Parts currently produced in this manner are shown in *Fig.* 3.

The parts illustrated in *Figs.* 4 and 5 are poured vertically into a zircon sand mold. They offer physical properties equivalent to forgings—and at a competitive price. They are large in size, showing that size limitations on shell castings are more economic than physical.

Casting Accuracy: Precision production in shell molding requires skill that is not available in most foundries. Conversely, when it is attainable, it is often unnecessary. For example, bearing and working surfaces on most shell-molded parts are not likely to be used in the as-cast condition. A slight amount of stock removal by grinding or a quick skin-cut will probably cost less than perfection attempted in the foundry. There are a number of surfaces used for joining and mounting that can be shell cast to size quite satisfactorily, however. Slow-speed gear teeth, *Fig.* 5, are now being shell cast to size. Another example of the precision possible is found in casting of automotive crankshafts where the width of the counterweight sections is held within 0.010 inch. No machining of clearance dimensions is required.

It is difficult to tabulate shell-casting tolerances because such figures are dependent largely on casting shape and size, tooling accuracy and the shell molding procedures followed. In addition, tolerance is dependent on the foundry, its work habits and its past experience with shell molding.

Normally the tolerance range is from ±0.003-0.008 inch per inch. However, one foundry engaged in shell molding will not guarantee to maintain tolerances closer than ±0.015 inch. Another, a shell-mold specialist, guarantees ±0.002 inch per inch. This foundry uses precision tooling, resin-coated zircon sand and steel-shot backing.

The tolerances quoted apply to dimensions which are parallel to mold parting lines. When tolerances on dimensions across mold parting lines are considered, another set of conditions must be evaluated. These include mold warpage, spread, loose sand and poor fit in core prints and mold contact faces. Because of these variables some foundries will not guarantee to hold tolerances of less than ±0.025 inch across a parting line. The specialist previously referred to will hold dimensions to ±0.002 inch if necessary. The general tolerance range is from 0.010 to 0.020-inch parting line error where adhesive bonding is utilized.

Fluid adhesives are helpful in minimizing error at parting lines. Further reduction of error is possible through pattern modification. As long as molding conditions remain unchanged, consistent dimensional results will be maintained.

Specific dimensional studies at Albion Malleable Iron Co. (reported in the *Transactions* of the Amer-

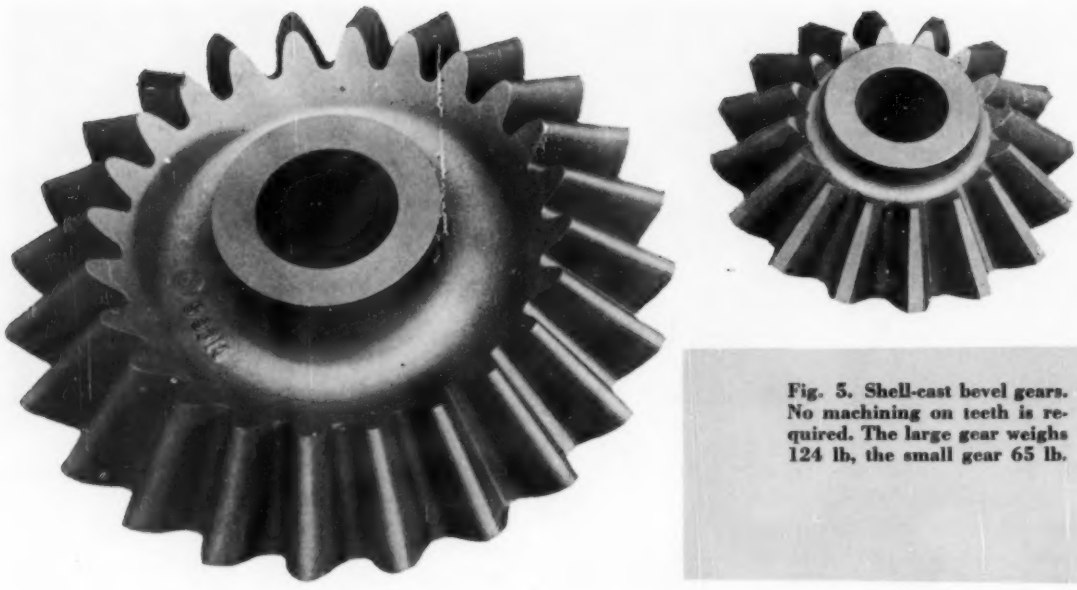

Fig. 5. Shell-cast bevel gears. No machining on teeth is required. The large gear weighs 124 lb, the small gear 65 lb.

ican Foundrymen's Society, Vol. 67, p. 81, May 1958) show that on a pearlitic malleable automatic transmission part, *Fig.* 6, standard deviations on a 3-inch diameter proved to be 0.002 inch per inch. Similarly, on a 6-inch outside diameter the deviations proved to be within 0.0013 inch per inch. On dimensions across the parting line on a 2-inch dimension deviations were 0.005 per inch. These measurements were taken from a job which is in continuous production.

TABLE 2 shows the tolerances maintained by the Central Foundry Division of General Motors Corp. These tolerances refer to pearlitic malleable castings as produced by green-sand and shell-cast techniques, and they apply only to dimensions on one side of the parting line. When measurements are taken across the parting line, 0.004 inch should be added to the figures. It should also be remembered that pearlitic malleable iron requires heat treatment after casting. This can result in warpage and dimensional error which can be corrected by straightening fixtures and press operations.

Castings which are not heat treated and are used in the as-cast condition also present some warpage problems. If shell-molding conditions are consistent and castings are handled properly at shakeout, this warpage can be compensated for and controlled. Examples of the control that can be attained are seen in the production of motor-end frames. In these parts the shell patterns are made out-of-round to compensate for warpage and produce perfect roundness. Whenever such compensation or form modification is made for a given casting condition, it can be maintained consistently.

In many instances shape and dimension tryout is recommended as normal procedure in tooling for difficult shell molding jobs. Standard shrink rules do not apply to this process and although some empirical calculations are available, tryout provides the most reliable method of determining final tool dimensions.

An important and sometimes limiting factor in the accuracy of shell-molded castings is the draft on patterns and core boxes on flat surfaces parallel to the stripping action. Although drafts as small as 0.002 inch per inch are in use, they cause excessive wear on the shell tooling and they create stripping problems. Stripping can be facilitated by stripper pins placed close to critical surfaces but abrasive wear still gives trouble. Experience has shown that a significant increase in wear results when draft is less than 0.5 deg. (0.009 inch per inch). Drafts larger than 1 deg result in very little abrasive wear and stripping is simplified.

Another consideration in establishing draft is subsequent machining. If a finish-milling or broaching cut is specified, a few more thousandths will make little difference and a comparatively open angle should be used. If a machining operation can be eliminated however, the low-angle draft will probably be justified.

In addition to draft, a number of other variables must be considered when tolerances are discussed. These are:

1. Surface flatness
2. Parallelism between surfaces
3. Angular relationships of surfaces
4. Shaft straightness
5. Degree of ovality
6. Concentricity of diameters
7. Roundness by total indicator reading
8. Fidelity of detail
9. Surface finish

10. Contour accuracy and consistency
11. Variation extremes and averages.

Because any or all of these factors have an effect on tolerance, no generalized statement concerning the limits of dimensional accuracy should be considered valid for all purposes.

Shell Cores: Currently shell cores are being used increasely in the foundry industry. These cores, of resin-coated sand, the same material from which modern shell molds are made, were first used in 1953 as a result of the cooperative research of the Beardsley & Piper Div. of Pettibone Mulliken Corp. and the Acme Resin Co. Today most resin producers offer coating resins, and several types of coating processes—hot, cold and warm—are now in use.

Individually resin-coated sand grains can be blown into heated shell core boxes without the separation of sand and dry resin. The blowing of shell molds is also possible. Resin-coated sand requires only about half as much resin as dry mixes for substantially the same strength and in this way it provides a major contribution to the reduction of mold-material cost.

Shell cores are a low-cost substitute for conventional cores in green-sand molds. Because the shell cores are hollow, they use less sand and permit use of less expensive binder. Also, since they are finished upon removal from the core box, dryers and curing ovens are not needed. Shell-core boxes, cast to size in cast iron, can be lower in cost than conventional sand-core boxes plus dryers. Shell cores withstand rough handling and can be stored indefinitely or used immediately after removal from the core box. When used in pouring molds, they usually collapse completely, leaving nothing but free-flowing sand at shakeout. Holes are extremely smooth, clean and sand-free. Gas evolved during pouring is provided with easy egress through the hollow core.

Table 2—Tolerances for Castings
(Pearlitic Malleable Iron)

Casting Size (in.)	Green Sand Process (in.)	Shell Mold (Unsupported) (in.)
0-1	±0.023	±0.006
1-2	±0.030	±0.012
2-3	±0.030	±0.018
3-8	±0.045	±0.030
8-12	±0.060	±0.041

Shell cores also provide greater strength than conventional cores and usually there is no need for reinforcing rods and wires. Thin sections and intricate shapes which are otherwise unattainable become possible. Precision holes cannot be produced by cores made in cast-to-size core boxes. In this application core boxes must be made by precision machining. Also, shell cores are as susceptable to core shift as other types and must be fitted accurately to obtain correct alignment.

While shell cores are integral parts of shell-mold assemblies it should be remembered that shell molds, by their nature, often eliminate the need for cores. It is in such cases that greatest economies and precision are achieved. If cores are not required and the holes can be produced by the shell molds alone, the entire cost of shell-core making, handling and fitting is eliminated. As an

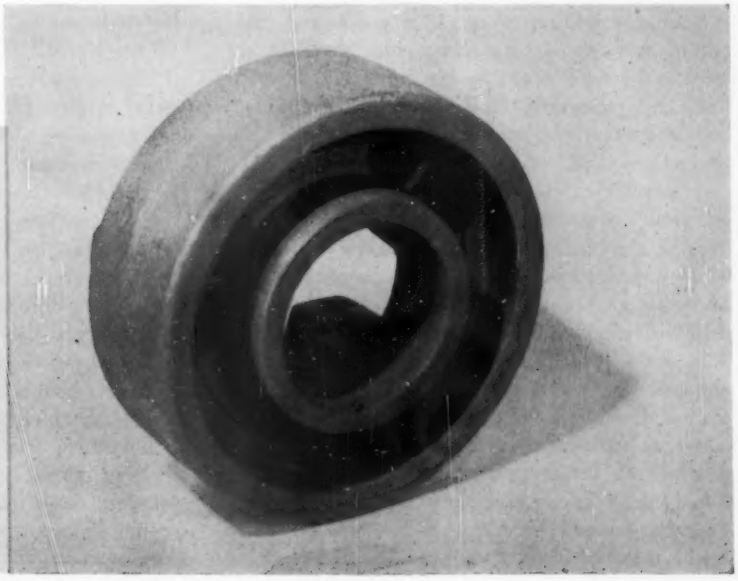

Fig. 6. Automatic transmission casting cast to within 0.002 inch per inch.

Fig. 7. End-yoke casting is produced without cores.

example, the part illustrated in *Fig.* 7 has been produced by both the shell-casting and the green-sand techniques. Comparative costs are $4235 for a green-sand pattern and core box, and $2840 for a shell-casting pattern. No core box was required for shell casting.

Generally, it is easier to hold close tolerances in a shell core than in a shell mold. This results from the differences in their action in the presence of molten metal. Silica sand grains expand approximately 0.006 inch per inch in the range from room temperature to around 450 F. Their expansion rate then levels off to nearly zero at around 1150 F. Stresses created at the mold-metal interface are excessive and are a primary cause of thermal cracking. Added to these are the dynamic and static pressures of the molten metal.

Similar conditions occur in a green-sand mold but in these the drying clay binder shrinks, permitting the sand grains to expand freely. In addition, the green-sand mold, being more resilient, does not set up the strain pattern found in a relatively rigid shell mold.

A number of remedies for these cracking conditions are available. They include cushioning additives in the shell-mold mixture, and mold design which induces controlled thermal cracking at unimportant points. Preheating of the mold is also helpful in eliminating fracture.

It is also important that the shell core box be dimensioned to control its behavior and effect on casting dimensions. If the core is hollow and collapses as shrinkage occurs, or if it is solid and restricts the shrinkage movement, suitable dimensional modifications in the core box must be made.

Expansion and shrinkage factors are generally predictable and in fully engineered shell-mold tooling, they can be controlled. Where precision conditions or complex casting shapes exist, the dimensional modifications made in the shell tooling, after initial trial casting, can be minimized by good engineering.

The foundry industry has much to do to capture the market that exists for shell castings. This refers to shell castings as they can and should be made. It also refers to shell castings made at prices competitive to those of green and permanent-mold castings.

Because shell castings offer significant savings not only in machining costs but in tooling and capital equipment their possibilities should be thoroughly explored. What is now needed is more tool engineering in shell molding and, conversely more shell molding in tool engineering.

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Miniaturized Thickness Gages

Accurate measurement of coating thickness inside small-diameter tubes is now possible with two miniaturized gages designed by the National Bureau of Standards.

These gages make use of the reflected field from eddy currents inside the specimen. They are capable of measuring internal coatings in 0.30-inch and 0.50-inch tubing having lengths of several feet with a resolution of less than 0.1 inch. The measurements are nondestructive and are localized to a small area.

Although the gages were designed primarily for measuring chromium plating in the bores of small gun barrels, they can be adapted for determining the thickness of chromium or other coatings on the interior surfaces of any small tubing.

The maximum thickness range of the gages has not been determined. However, the fact that calibration curves are nearly linear up to a thickness of about 0.008 inch indicates that considerably higher thicknesses, probably up to 0.015 or 0.02 inch, can be measured. Over-all accuracy is ± 10 percent.

Improving Tap Life

TAPPING HIGH-STRENGTH ALLOYS such as René 41; S-816, H-11, AISI 4340 and titanium is easier than drilling them, because drilling involves both cutting and extrusion, while tapping is a straightforward cutting operation, and these materials are easier to cut than to extrude. As a general rule, if a material can be drilled using high-speed steel drills, it can be tapped with high-speed steel taps. But even with drillable materials tap life will be seriously shortened unless tap design and cutting conditions are suitable for the material.

Tap Design: To minimize breakage in tapping chip load per tooth must be reduced below the breakage level. For a tap, the chipload t, in ipt, is

$$t = \frac{\sin\delta}{nN}$$

where δ is chamfer angle, deg, n the number of threads per inch and N the number of flutes. From the equation it is evident that n is fixed for a given tap, so that chip load can be reduced either by decreasing the chamfer angle or by increasing the number of flutes. The effect of chamfer angle is shown in *Fig.* 1. The effect of both chip load and chamfer angle, calculated from the equation, is given in the accompanying table.

The high yield strengths of the high-strength alloys cause taps to produce tight holes that rapidly wear tap chamfer relief surfaces and tap thread flank surfaces. A higher-than-normal chamfer relief angle helps (although it reduces the support of the cutting edge) and radial relief of the tap threads is helpful. But after making all possible mechanical improvements, a hard-case surface treatment nearly always gives an additional improvement in tap life.

In the hardness range between R_C 52 and 56, conventional taps fail by severe chipping of the thread crests, usually on tap reversal. Above R_C 57, tapping is almost impossible. Below R_C 50, it should be possible to obtain a life of 25 to 50 holes (¼-28 and ⅜-28 taps, tapping through holes about two

From *Metal Cuttings*, January 1959 and October 1960. Published by National Twist Drill and Tool Co., Rochester, Mich.

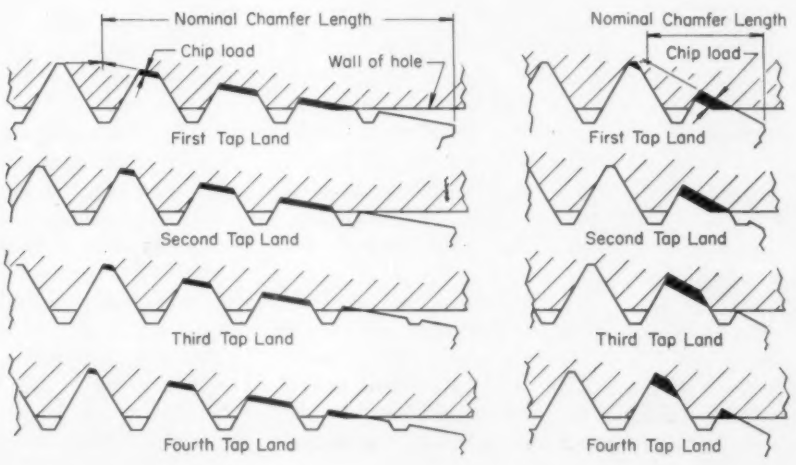

Fig. 1. Plug chamfer design (left) imposes 73 percent less chip load per tooth than bottoming design shown at (right).

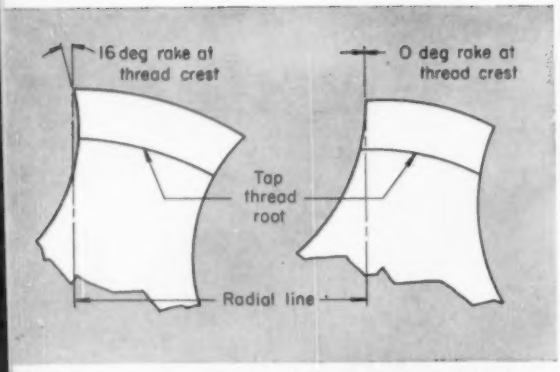

Fig. 2. Negative-rake fluting (right) has a stronger crest edge than standard fluting (left) that chips easily.

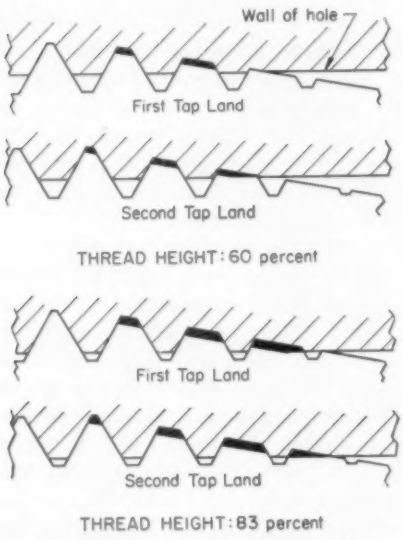

Fig. 3. Increased thread height brings more tap teeth into contact with the work and increases tap driving torque.

Chip Load per Cutting Edge (inch)

Tap Size and Threads per in.	Number of Flutes	4.5-deg. 9-thread chamfer*	10.5-deg 4-thread chamfer†	17-deg 2.5-thread chamfer‡	29-deg 1.5-thread chamfer§
6–32	2	0.0012	0.0028	0.0046	0.0076
	3	0.0008	0.0019	0.0030	0.0051
6–40	2	0.0010	0.0023	0.0036	0.0061
	3	0.0007	0.0015	0.0024	0.0040
10–24	2	0.0016	0.0038	0.0061	0.0101
	3	0.0011	0.0025	0.0041	0.0067
	4	0.0008	0.0019	0.0030	0.0051
10–32	2	0.0012	0.0028	0.0046	0.0076
	3	0.0008	0.0019	0.0030	0.0051
	4	0.0006	0.0014	0.0023	0.0038
¼–20	2	0.0020	0.0045	0.0073	0.0121
	3	0.0013	0.0030	0.0049	0.0081
	4	0.0010	0.0023	0.0037	0.0061
¼–28	2	0.0014	0.0033	0.0052	0.0087
	3	0.0009	0.0022	0.0035	0.0058
	4	0.0007	0.0016	0.0026	0.0043
⅜–16	3	0.0016	0.0038	0.0061	0.0101
	4	0.0012	0.0028	0.0046	0.0076
⅜–24	3	0.0011	0.0025	0.0041	0.0067
	4	0.0008	0.0019	0.0030	0.0051
½–13	3	0.0020	0.0047	0.0075	0.0125
	4	0.0015	0.0035	0.0056	0.0093
½–20	3	0.0013	0.0030	0.0049	0.0081
	4	0.0010	0.0023	0.0037	0.0061
¾–10	4	0.0020	0.0045	0.0073	0.0122
¾–16	4	0.0012	0.0028	0.0046	0.0076
1–8	4	0.0025	0.0057	0.0092	0.0152
1–12	4	0.0016	0.0038	0.0061	0.0102
1½–6	4	0.0033	0.0076	0.0122	0.0203
1½–12	6	0.0011	0.0025	0.0041	0.0067

*Taper style tap ‡Semibottoming style tap
†Plug style tap §Bottoming style tap

diameters deep). A modified flute shape, *Fig.* 2b, gives better support to the thread crest edges, reduces the tendency toward chipping and improves tap life. This modified shape has a negative rake angle on the cutting portion of the chamfer and, as with other tools, the negative rake angle increases the tapping torque. However, less torque is required by negative rake taps than by standard design taps, *Fig.* 2a, whose thread crests have chipped after tapping a few holes.

Cutting Conditions: The effect of thread height on tap life is shown in *Fig.* 3. As thread height increases, loading on the tap increases. Calculations indicate that increasing thread height from 50 to 75 percent almost doubles the percent of basic thread area removed. Reducing thread height reduces tap driving torque and increases tap life. Tests show that adequate strength for most purposes is developed if tapped thread height is reduced to 50 or 60 percent of the basic thread form height. Drills for improved tap life can be selected according to data presented in the December 1958 Reference Sheet, "Drilling Holes for Tapping," in this magazine. Dull drills, since they harden the metal to be tapped, cause shortened tap life, as do undersized holes. Misalignment of hole and tap, tap runout and erratic spindle rotation also shorten tap life.

All of the high-strength alloys can be more easily tapped when an active cutting fluid is used. In the hardness range above R_C 52, active chlorinated solvents lengthen tap life significantly. Recent tests (tapping AISI 4340 at a hardness of R_C 54 to 56 with ⅜-24 taps) demonstrated the effectiveness of these solvents as cutting fluids. With activated tapping oil, an average tap life of less than one hole was obtained; with inhibited trichlorethane, 5 holes; with trichlorethylene, 9 holes. Tap life jumped to 22 holes using carbon tetrachloride. Toxicity of these fluids demands caution in their use.

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For two years now, Dale Long has seized every spare moment of the present to ponder the Society's future. Here, during a wait at the Memphis airport following an on-campus conference at Mississippi State University and just prior to the Los Angeles meeting, the ASTME president studies the final report that was boiled down by the Long-Range Planning Committee.

Long-Range Planners Report

WITH EXPEDITION and without exception, the National Board of Directors ticked off their approval of the Long-Range Planning Committee's recommendations during the semiannual meeting at Los Angeles.

But the alacrity with which they dealt with Item 17 on a long agenda was deceptive. Behind the item—"Long-Range Planning Committee Report"—stood a 67-page document which distilled the soul-searching and stock-taking deliberations of nine marathon meetings, innumerable committee and subcommittee discussions, 3000 man-hours of give and take, 200,000 miles of travel to and from meetings, and—for each member—30 pounds of paperwork stacked 15 inches high.

The unequivocal acceptance of the LRP program by the board could not be attributed to any bended knees on the part of the directors. Rather, it was because the two groups—the LRP Committee and the Board of Directors—were largely the same people wearing different hats. Meeting as the board, the directors merely formalized the decisions they had reached as a closed-session committee in their agonizing appraisal of the Society's past, present and future posture.

As President Dale Long put it, the LRP report represented "the best thinking of the best minds that you—the membership—have elected."

Besides the national directors, both incumbent and elect, the LRP Committee was comprised of the national officers; three past national presidents, Harold Collins, George Goodwin and Wayne Ewing; directors whose terms expired during deliberations of the committee; and the former chairman of the National Constitution and By-Laws Committee, Arthur Cervenka. Because of illness (resulting in death a few days after the Los Angeles meeting), Goodwin had recently yielded the chair to Long. The group was established in early 1959 to study ASTME's structure, functions, purposes and methods.

In tackling this somewhat prodigious assignment, the LRPC settled on a three-step procedure for each study of a particular facet of the Society: first, a historical review; then a performance evaluation; and finally a determination of a future course of action. They resolved their investigation into 21 areas, ranging across the whole spectrum of Society make-up, interests and endeavors.

The results were many major and many more minor changes in ASTME. But, in essence, the LRP report as approved by the Society's governing body was a reaffirmation of the basic democracy and goals of the 28-year-old organization. The report corroborated the objective upon which the Society was founded and toward which it has been directed since 1932, and declared that it should not be altered in the next 15 years. Its initial and basic recommendation was:

"It is our sincere hope that in 1975 the major objectives of the So-

ciety will continue to be the establishment of the Society as the leading engineering and technical service organization in the field of manufacturing."

More than any other one thing, LRPC stressed that the basic reason for its existence and the basic motivation for its recommendations was to increase individual member participation in the activities and benefits of the Society.

Then, *with service to the individual member uppermost in its mind*, the LRPC recommended three secondary goals:

- Acceleration and expansion of the broad educational activities of the Society
- Expansion and refinement of organizational structure to parallel the accomplishment of this program
- Immediate initiation of an ASTME center development with facilities to house the present Society activities and with the capability of being expanded.

In physical terms, the long-range planners set the 1975 goal at 300 chapters and 70,000 members.

Highlights of LRP Recommendations

Behind the aging patina of Los Angeles' Ambassador Hotel and within the elegant confines of the Embassy Room, the long list of recommendations were intoned one after the other by John Groomes of Headquarters, and voted on like clockwork.

Before action on specific recommendations, however, President Long emphasized that constitutional changes recommended by LRP and approved by the Board of Directors *must still be approved by the entire membership of the Society, by referendum ballot*, before they become final.

Among the most significant decisions, some of which will be explored in detail in subsequent issues of THE TOOL AND MANUFACTURING ENGINEER, are the following:

MEMBERSHIP—In a move to upgrade the membership, the LRP Committee recommended that qualifications of Senior Members be revised to require a college degree in science or engineering and/or professional registration status, plus five years' experience; or Student and Regular membership accumulating 10 years; or 10 years' experience in tool and manufacturing engineering. Minimum age for Senior Member would be 30.

A "grandfather clause" in the recommendation would allow those Senior Members now in good standing in the Society to retain their membership grade as long as they remain in good standing.

A new grade of Regular Member would be established. This grade would encompass the former qualifications of Junior Member and the rights (including voting rights) of former Senior Members. The Regular Member category would, in effect, absorb the present Junior Members and the "low side" of the present Senior Member qualifications. Junior Member would be abolished.

MEMBER SERVICES—Dovetailing with the board's endorsement at Los Angeles of the program for technician certification being promoted by the National Society of Professional Engineers, the LRP report recommended that member services of the Society be oriented generally toward the technician-level member but not to the exclusion of the scientific or professional member. The board disclaimed any intention of moving the Society in the direction of technician status; rather, it stressed its intentions of upgrading the membership and of increasing member participation. All member services of the Society, LRPC emphasized, are aimed at bridging the gap between formal schooling and industry.

EDUCATION—In this prime area of member service, the LRP report postulated that ASTME should direct its educational programs toward the member first, then the student, then industry as a whole.

LRPC suggested modification of the present $11,000-a-year scholarship program to include a program of grants for education and research. The committee envisaged grants not only as scholarships to worthy students, but also for faculty research, salaries, course and curricula development, loans to students, and so on.

It called for a subcommittee to investigate the feasibility of establishing an ASTME Foundation to administer all such grants, not only in education but in research, and to report its findings at the 1961 Annual Meeting.

In addition, LRPC recommended the establishment of correspondence courses, specialized courses in various phases of tool and manufacturing engineering, and ASTME sponsorship of in-plant training programs to effect the engineer's transition from formal schooling to industry.

The LRPC further called for the creation of a central library service of tool and manufacturing engineering bibliographical data.

RESEARCH—Aside from envisioning an integrated administration of educational and research grants by an "ASTME Foundation" as described above, LRPC affirmed that Society-sponsored research should continue to concentrate upon the *applied* fields of manufacturing engineering and technology. The Society, LRPC decided, should not build its own research facilities but should continue to utilize on a competitive bid basis the existing independent and institutional research facilities.

REGIONAL COUNCILS—The Society should encourage regional councils of chapters only on an

informal basis. Such councils, however, should submit minutes of their meetings to Headquarters to comply with provisions of Michigan corporate law, LRPC contended.

The long-range planners conceded that regional councils will continue to expand. Although a few councils might have been organized for political reasons, LRPC admitted, today their primary purpose is the solution of mutual problems.

However, in the thinking of the committee, the purpose of the Society—to advance the knowledge and practice of manufacturing technology to our members and through our members to society—cannot be achieved as effectively "from a top-down basis as from the thinking of the total membership from the bottom up."

In short, the chapter remains the most effective unit. "Herein lies our strength," the LRP report stated. "Chapters should guard jealously their individual prerogatives within the institution."

EXPOSITIONS—Regional tool shows, similar in size and scope to the Western Expositions, should be sponsored whenever justified. (The board took under advisement a proposal from the Southeast Council to hold a regional exposition in conjunction with the 1965 semiannual meeting in Atlanta.)

The committee urged the formation of a permanent group, similar to LPRC itself and to the former Progress Committee, which would meet annually. This body would objectively review the results being obtained in the LRP programs and would propose reorientation of the long-range provisions as necessary.

The directors approved LRPC's recommendation that the title of Executive Secretary Harry E. Conrad be changed to General Manager. This change, not involving the Constitution, became effective immediately. The committee felt that the new title "more adequately depicts and connotes the role of this individual to the industrial and management groups with whom he comes into contact. . . ."

Funds were allocated to cover expenses of gathering member petitions and holding a referendum on proposed constitutional changes, and of publishing the revised Constitution and Bylaws.

Committees Named to Implement Report

President Long appointed the following subcommittees to carry out various LRP studies and recommendations, and called on them to report at the 1961 Annual Meeting in New York:

FINANCIAL PLANS—A committee to study the monetary ways and means of implementing programs growing out of LRP recommendations. Long himself is chairman. Members are Past President Wayne Ewing, Vice President William Moreland, Treasurer H. Verne Loeppert, and newly installed Director Duane H. Brighton.

MEMBERSHIP DUES—A committee to evolve a dues structure for the new membership lineup of Senior, Regular, Student, Associate, Affiliate, Honorary and Life. Ewing is the chairman; members are Long, Directors Dean Saurenman and Charles M. Smillie.

RESEARCH AND EDUCATIONAL GRANTS—Past President Harold E. Collins, chairman; members, Directors Albert Underwood, Jr. (newly installed), and Leslie C. Seager, plus Howard C. McMillen, re-elected chairman of the Research Fund Committee, and Oliver S. Hulley, chairman of the National Education Committee.

CORRESPONDENCE COURSES—National Secretary Francis J. Sehn, chairman; Directors Bruce Fairgrieve and Joseph L. Petz.

CENTRAL LIBRARY SERVICE—Leoppert as chairman, Directors G. Ben Berlien and W. J. Pender.

COMMITTEE STRUCTURE—A committee to study all the other Society committees, with special attention to the number of members and the cost of committee travel. Moreland is the chairman; members are Director Irving S. Buck and Arthur Cervenka, consultant member of the National Constitution and Bylaws Committee.

HEADQUARTERS SITE—A committee to succeed the earlier group which was dissolved after the Board of Directors had accepted its recommendation that ASTME Headquarters remain within a 40-mile radius of downtown Detroit. (A report on the first Site Committee's findings will be found overleaf.) The new Site Committee is charged with pinpointing the Headquarters location in the Greater Detroit area. Vice President Philip R. Marsilius will also be chairman of the new committee; members are Moreland, Saurenman, former Director Cecil Chapman and newly installed Director Smillie.

HEADQUARTERS BUILDING—A committee to work with the Site Committee and with architects in planning the new Headquarters of the Society. Vice President David A. Schrom heads the group; members are Vice Presidents Marsilius and Frank F. Ford, Arthur Cervenka, and newly installed director Albert Underwood, Jr.

After five resolutions of commendation and appreciation—including one for arduous service to the Long-Range Planning Committee by Chairman George Goodwin, who suffered a setback in his fight for recovery after he arrived in Los Angeles and had to be flown back to a Dayton hospital, only to succumb within the week—the Board of Directors adjourned.

Their only remaining job was to translate long-range plans into long-range deeds.

Directors Approve 1961 Budget

A FISCAL YEAR 1961 BUDGET of $864,000 for Society committees, departments and projects was approved by the National Board of Directors during their semiannual meeting in Los Angeles. This allocation, added to previously approved budgets for tool shows, ASTME seminars, the monthly magazine and the 1961 Directory of Suppliers, brings the total budget in excess of $2 million.

In another action that produced possibly the most discussion and involved the least amount of money, the board endorsed the proposed technician certification program of the National Society of Professional Engineers and assigned responsibility for coordination of the activity within ASTME to the National Professional Development Committee. Chairman Charles H. Thuman of NPDC reported that the Society has been asked to sit in on NSPE phrasing of the technician certification program.

The directors also endorsed the revised Model Law as written by the National Council of State Boards of Engineering Examiners (NCSBEE).

The board elected the following Annual Nominating Committee to select a slate of 1962-3 directors: Vice President Philip R. Marsilius, Charles H. Thuman, Chairman Robert Johnson of the National Membership Committee, and Directors Irving H. Buck and Albert Underwood, Jr.

Also approved by the board was an exchange secretarial membership with the Society of Automotive Engineers. Such an exchange would involve General Manager Harry E. Conrad of ASTME and General Manager Joseph Gilbert of SAE.

Love at First Site

It was a case of love at first site when the Board of Directors took up the question of relocating the Society's Headquarters.

Meeting at Los Angeles Nov. 16-17, the board unanimously adopted the Headquarters Site Committee's recommendation that the Society's home remain within 40 miles of downtown Detroit, the city of its birth.

Everyone had his say. President Dale Long saw to that.

But no one substantially challenged the special committee's three-month analysis. A charge that the site evaluation was a whitewash job in favor of Headquarters staff personnel who didn't want to relocate brought disclaimers from all, including General Manager Harry E. Conrad who said:

"You can't get rid of us by moving.

"A poll of all Headquarters administrative personnel disclosed no one who would not be willing to follow the Society if it should choose to move to some other city or state. Nor did anyone at Headquarters attempt to 'snow' any member of the Site Committee or this board with information that would sway their decision one way or the other."

The board also quashed a suggestion that the study was done too hurriedly. The 56-page report spoke for itself, decided the directors. They forthwith formally endorsed the recommendation, dissolved the committee, and approved the appointment of a new Site Committee to pick out the specific site in the Detroit area for erection of the new Headquarters facilities as envisioned by the Long-Range Planning Committee.

Members of the Site Committee, which was specially designated by President Dale Long last August 11, were Vice President Phil Marsilius of Bridgeport, Conn., chairman; and Directors Duane H. Brighton, Peoria, Ill.; Irving H. Buck, Dallas; Frank F. Ford, Atlanta; and Albert Underwood, Jr., Windsor, Ont. (Marsilius will also serve as chairman of the new Site Committee.)

Criteria in the site evaluation were statistics on national centers of population, industry and Society membership; transportation facilities; federal, state and local tax situations; personnel, including availability and cost of relocating; proximity to educational institutions; area population and economic trends; area cost of living; and area prestige.

On these bases, the committee narrowed its study first to a region—the five-state East North Central area—and then to half a dozen cities—Chicago, Cincinnati, Cleveland, Detroit, Milwaukee and St. Louis. Upon second sifting of all factors, the committee further narrowed the field to Chicago and Detroit. With one major exception, the proximity and availability of transportation, Detroit won out over Chicago in the committee's opinion.

On business climate, the committee declared: ". . . The metropolitan Detroit area is very progressive and surpasses the Chicago metropolitan area in this regard. Although Michigan connotes the throne of unionism to many people, its capital investments annually and the value added to manufacture do not justify much of the criticism which has been leveled at the area."

In conclusion, the committee said: "Just as Detroit is synonymous with mass production techniques, so the Society is also synonymous with Detroit."

Panel Analyzes Soviet Manufacturing

Panel jointly sponsored by ASTME and UCLA hears Moderator Walter Kassebohm of the Marchant Calculating Machine Co., warn that U.S. production superiority over Russia may not last long. A U.S. lathe that sells in Western Europe for $10,000, he said, compares with a similar Soviet model that sells for $3,800. On a jig borer, the comparison is $46,000 to $26,000. The panel discussed "The Race for Manufacturing Supremacy: An Evaluation of Manufacturing Progress in the Communist World."

THE RUSSIANS are strong in theoretical science and technology but generally weak in application of theory in industry, a panel of experts decided at a special public-interest program sponsored by ASTME during the Western Engineering Conference and Exhibit.

The experts, brought together by ASTME and the University of California at Los Angeles, declared that Communist manufacturing is still as much as a half century behind that of the United States—but watch out for the next ten years.

Walter Kassebohm, executive vice president of Marchant Calculating Machine Co., Oakland, Calif., moderated the panel of engineers who have all had looks at production facilities behind the Iron Curtain. Participating were Nevin L. Bean, staff engineer, Ford Motor Co.; Robert Kudlich, director of Computer R & D, A. C. Spark Plug Div. of GM; Henry Noebels, manager of application engineering, Beckman Instruments; and Edward E. Tuttle, executive vice president, Essick Mfg. Co.

The panel pointed to recent startling advances in automation and predicted that this concept, broadly applied, would within a decade put the Russians' products—particularly machine tools—into highly competitive positions with American products on the international market. (The Soviet Union recently reported that exports rose 25 percent in 1959 over 1958, and that 25 percent of these exports went to capitalist nations. Of the 42 billion-ruble export business, machinery accounted for 4.7 billion rubles worth, the Reds claimed.)

Bean said, "It's the plans and prototypes that are impressive in Russia, not what they have now."

Convention Figures

Mixing business with the pleasure of the semi-annual dinner party at the Ambassador Hotel are Rudolf Regen, chairman of the Los Angeles Host Committee, and Vice President William Moreland of Ashland, Ohio. They are studying some figures on the ASTME's Western Engineering Conference and Exhibit: 586 total attendance at technical sessions and Techtours; 338 at the banquet itself; and 253 on seven plant tours. Next Western show is set for 1962.

L.A. Tool Show:

The third Western Engineering Conference and Exhibit drew a registered attendance of 11,220 during its five-day run in Los Angeles' gleaming Memorial Sports Arena. Some 185 exhibitors—many of them distributors displaying the wares of more than one company—occupied 37,000 sq ft of booth space to show off over 2000 pieces of production equipment. More than 500 devices were new. Theme of the show was "America's Success Through Manufacturing Efficiency."

Floating water faucet, familiar to past ASTME tool show visitors was a barrel of mysterious fun for students who passed the booth of Wesco Tool. Below, a student tries to guess the weight of a huge billet of direct-chilled cast aluminum, exhibited by Pioneer Aluminum as the first production stage in the manufacture of tooling plate. His only clue: it weighed over 10,000 lb. Students from area technical schools, colleges and universities toured the show on Nov. 16. The same day, 92 educators were guests of ASTME at a special luncheon.

Exhibit of French engineer and manufacturer Phillipe Durand was a family affair. Booth visitors as Durand operates a boring mill he designed are his California-born wife Margaret and their daughter Noelle, 6½, who is brushing up on her French reading. The family lives in Paris. Durand's firm, the Societe des Engrenages Durand, makes worm gears and machine tools.

Production Arena

California Day Luncheon, kicking off ASTME's Western Engineering Conference and Exhibit, drew 240 persons to Los Angeles' Sports Arena, including a double head table of distinguished industrial and educational leaders of the area. Left to right in this picture are Prof. Morris Asimow of UCLA's Engineering Department, President K. T. Norris of Norris-Thermador Corp., President Courtlandt S. Gross of Lockheed Aircraft Corp., and General Manager Harry E. Conrad of ASTME. Luncheon speaker Maj. Gen. O. J. Ritland, commander of the Air Force Ballistic Missile Div., posed these challenges to tool and manufacturing engineers: "We must cut launching costs by at least one order of magnitude. . . . We must develop practical space power supplies. . . . And we must simplify our systems and enlarge greatly our reliability quotient. The critical influences of these critical days are time and technology."

Two Canadians, George Churchill, vice chairman of the National Program Committee, and G. M. Dilly, past chairman of Grand River Valley chapter, stopped by the American SIP Corp. booth to see the largest machine on the Arena floor. Here Churchill inspects the punched tape that is operating the 17-ton jig boring and milling machine in the background. Numerical control and automation were the standout features of the exhibit, and also occupied two special sessions of the technical programs which ran simultaneously in the Ambassador Hotel.

Past President

George A. Goodwin Dies

GEORGE A. GOODWIN, national president of the Society two years ago, died on November 27 in his hometown of Dayton, Ohio. Just 10 days before, on November 17, his final service to ASTME reached its culmination in the Board of Directors' adoption of the Long Range Planning Committee report at the Semiannual Meeting.

When the LRP Committee was formed, George Goodwin was chosen to head the group because of his long and distinguished service to ASTME as well as his detailed knowledge of the Society and its growing pains. Through his leadership, the long range planners made an intensive, thorough, two-year study of ASTME's past, present and future, its purposes, its membership and its government. Goodwin supervised the final compilation of the LRP report and, though in ill health, joined his committee in Los Angeles last November to present the report to the Board.

Because of illness, he was unable to be present at the meeting when the report came up before the directors. "But due to the fact that he was there in Los Angeles," said General Manager Harry Conrad, "his influence was felt at the presentation of the Long Range Planning report and throughout the entire Board meeting."

Born in Auburn, R. I., Goodwin became a tool engineer in 1910. In 1938 he joined ASTE as a charter member of Dayton chapter.

Goodwin was never too busy to serve his home chapter. In his early ASTE days he held various posts in the Dayton chapter, including that of chairman. And when he became active on the Society's national level, he retained his interest in the local group, often serving it in an advisory capacity.

"Chapters are the foundation stones of our Society," he once said. "Their autonomy and individual support of their members are the true sources of our strength."

It was through the Finance Committee that Goodwin came into prominence on the national level. Appointed to that group in 1946, he held the chair the next year. In '48 he was elected national treasurer, a post he held for three terms.

Goodwin was a fundamentalist in financial matters. And to him ASTME owes its solid financial footing. Treasurer during the period of post World War II economic adjustment, he guided the Society's economy through its formative stages with his sound financial policies. Due to his efforts, the Society reserves were set up and the trust fund established.

Having served his first term on the Board of Directors in 1940, he was re-elected a director in '48 and remained on the Board until his death. He became ASTE vice president in '57 and the next year was elected national president.

During Goodwin's administration, membership passed over the 40,000 mark and placed the Society in the ranks of the largest engineering groups in the country. Communications were improved, especially on the chapter level. But the greatest strides forward were in the field of education.

President Goodwin, who had long been a member of the advisory committee on tool engineering at Sinclair College, used every opportunity to stress the importance of improving and advancing education. Alarmed by the shortcomings with which the country's educational system was facing an ever increasing need for scientists and engineers, he once offered Society members this challenge: "I don't have a great white charger from which to launch a crusade but I invite every ASTE member and industrial executive to make his own investigation in his own community and take action where it will do the most good."

For many years Goodwin was works manager of Master Electric Co., division of Reliance Electric & Engineering Co. Scheduled to retire last spring, he delayed his retirement when management requested him to remain in service a little longer.

Survivors include his wife, Berna, and a daughter, Mrs. Mildred Leckrone, both of Dayton.

director nominees named

The Annual Nominating Committee presents the following list of nominees for the Board of Directors, confident that each is thoroughly qualified to carry out the precepts of our Society:

	William Moreland	
Frank F. Ford	Verne Loeppert	Philip R. Marsilius
Duane H. Brighton	Albert Underwood, Jr.	Francis J. Sehn
G. Ben Berlien	Willis J. Potthoff	Dean Saurenman
Arthur Cervenka	Carl A. Darger	George C. Bennett
Robert M. Johnson	Arthur F. Gould	James R. Matthew
David A. Schrom	Clinton J. Helton	Sidney B. Jeffreys

A critical study of these candidates has convinced us that they not only represent the interests of Society members but have a deep personal concern for the purposes and progress of ASTME. Through their background of experience in the Society, they have demonstrated the ability and judgment required for service in such a responsible position.

Each nominee has the consent of his family and company to devote the necessary time to the Board should he be elected a director next May at the Annual Meeting.

Respectfully submitted,

The 1960 Nominating Committee

At the Annual Meeting in New York next May, the House of Delegates will elect 14 national directors. The retiring president, H. Dale Long, automatically becomes the 15th director. Following are the nominees for the 1961-62 Board.

William Moreland, national Vice President, is completing his fourth term as director. His long and varied service to the Society includes terms as ASTME secretary as well as second, third and fourth vice president; the chairmanship of the Director Nominating Committee last year; ten years of membership on the National Standards Committee, of which he was both chairman and vice chairman; and service on the name-change, officer nominating and policy coordinating committees. A past chairman of Rockford chapter, Moreland is now a charter member of the Mansfield ASTME group. He is vice president in charge of manufacturing at F. E. Myers & Bro. Co., Ashland, Ohio.

David A. Schrom, a vice president and past secretary of ASTME, is works manager of York Div., Borg Warner Corp. A past chairman of the York chapter, Schrom has served on the national level as vice chairman of the Public Relations and Technical Publications committees; as a member of the Education and Progress committees; as ex-officio member of the Constitution and Bylaws Committee; and as chairman of Project Revisions #9 ASTE Handbook. A registered professional engineer in the state of Pennsylvania, York is an industrial engineering graduate of Penn State.

Philip R. Marsilius, now serving his fifth term on the Board of Directors, is an ASTME vice president and past national treasurer. On the national level he served three years on the Program Committee, one of them as chairman. Marsilius, who at one time was tool and die industry adviser to the Metalworking Equipment Div. of National Production Authority, Washington, is now executive vice president of the Producto Machine Co., Bridgeport, Conn. He has held various offices in the Fairfield County chapter, including that of chairman. Graduated from Massachusetts Institute of Technology with a master's degree. Marsilius is a past president of NTDMA.

Frank F. Ford, a national vice president, is now serving his third term on the Board. Formerly an associate professor of chemical engineering at Georgia Tech, Ford now directs the operations of Ford Supply Co., Frank F. Ford & Associates and Dixie Engineering & Mfg. Co.—three organizations which he founded during the last eleven years. A past chairman of ASTME's Atlanta group, he has also headed ASM's Georgia chapter. His other professional affiliations include the American Welding Society, the National Society of Professional Engineers and the Georgia Engineering Society. Ford, a graduate of Yale University, is active in the Atlanta Chamber of Commerce and Rotary Club.

H. Verne Loeppert, currently ASTME treasurer, joined the national officer group as secretary in 1959. He held the chair of the National Finance Committee in 1958 after having served as a committee member the year before. Appointed to the National Membership Committee in '51, he was chairman of that group for two years beginning in '55. Vice president of Boyd Wagner Co., Chicago, and a registered professional engineer in the state of Illinois, Loeppert has served as chairman, vice chairman and treasurer of Chicago chapter. He is a commander in the U. S. Naval Air Reserve and is president and director of the Illinois Engineering Council. Loeppert attended the University of Chicago.

Francis J. Sehn is presently national secretary of the Society. Chairman of the National Technical Publications Committee for six years, he has also served on the Annual Nominating and the National Standards Committees. He represents ASTME on the Honor Award Committee of the Pressed Metal Institute and has served two terms on the Society's Board of Directors. A registered professional engineer and a member of the Wayne State University faculty, Sehn is the owner of a Detroit consulting engineering firm, The Fran Sehn Co., and is president of Press Automation Systems, Inc. He also holds membership in SAE.

Arthur Cervenka is presently consultant to the National Constitution and Bylaws Committee, which he formerly served as member, vice chairman and chairman. He is also vice chairman of the National Finance Committee. Employed at Grumman Aircraft for the past 20 years, Cervenka has consistently advanced from his first position as draftsman to his present post as manager of equipment and process engineering. A graduate of Columbia University, Cervenka is chairman of the ASA committee for accuracy of machine tools, and is a past chairman of Aerospace Industries Association's manufacturing equipment committee. He also worked on the revision of the *Tool Engineers Handbook.*

G. Ben Berlien, a director serving his fifth term, is in charge of the current Director Nominating Committee. After two years membership on the National Editorial Committee, he spent a term as chairman of that group. Berlien has headed the Golden Gate chapters of both ASTME and ASM. As a lecturer, he has addressed more than two hundred chapters of various technical societies. A partner in the Industrial Steel Treating Co. of Oakland, Calif., he was a conferee to the World Metallurgical Congress. Berlien, who frequently writes articles for the metalworking publications, contributed to both the original and second edition of the *Tool Engineers Handbook.*

Sidney B. Jeffreys has successively held the Piedmont chapter offices of secretary, treasurer, second vice chairman, first vice chairman and chairman. In addition, he has acted as national delegate and served on the National Public Relations Committee. Jeffreys, who is president and treasurer of Jeffreys Engineering & Equipment Co., was general chairman of Piedmont's on-campus conference at North Carolina State in 1956. Listed in "Who's Who in Engineering," he is a director of the North Carolina Design Foundation and a member of ASM, the American Machine Tool Distributors Association, the National Society of Professional Engineers and the North Carolina Society of Engineers. Jeffreys holds a B.S. degree from Virginia Polytechnic Institute and an M.S. degree from M.I.T.

Clinton J. Helton, owner of Clint Helton & Co., is a member of the National Membership Committee, which he has served since 1953. A charter member of Denver chapter, Helton became chairman in 1953 after having served on the program and membership committees and as second and first vice chairman. In addition to these offices, he was instrumental in establishing the Rocky Mountain Executive Council of the Rocky Mountain Chapters. He attended the University of Cincinnati, later serving a machinist apprenticeship at the Hamilton plant of Baldwin-Lima-Hamilton Corp. Helton is a member of ASM and the Engineers Club, Ltd., of Denver.

Arthur F. Gould, a former chairman of the National Education Committee, joined ASTME's Lehigh Valley chapter in 1954. A registered professional engineer in Pennsylvania, he has been the head of the Department of Industrial Engineering at Lehigh University since 1953 and a member of the faculty since 1947. Acting as consultant to many industrial companies, Gould has presented technical papers at ASTME meetings and is coauthor of the textbook, *Manufacturing Processes and Equipment.* His other activities include the office of chairman and member of General Council for the Industrial Engineering Div., American Society for Engineering Education. Gould is also a member of ASME and AIIE.

George C. Bennett, a member of the National Public Relations Committee until 1959, was chairman of that group when the Society received the National Public Relations Award for Industrial Coverage. Bennett is the organizer of ASTME's Framingham chapter and was instrumental in the forming of Long Island chapter, of which he is a past chairman. In 1951 he was in charge of arrangements for the Annual Meeting in New York. Manager of Field Services at Lapointe Machine Tool Co. in Hudson, Mass., he has been a field editor of THE TOOL AND MANUFACTURING ENGINEER for the past four years. Bennett is affiliated with ASM, ASME and the Research Institute of America.

Carl A. Darger, who twice served as chairman of the National Membership Committee, is presently presiding over the National Finance Committee, of which he was vice chairman last year. Darger joined the Society in 1949 and the next year became program chairman for the Muncie chapter. In the succeeding years he served the chapter as public relations chairman, second vice chairman, first vice chairman, chairman and national delegate. The owner of Carl A. Darger & Associates since 1948, Darger is active in church work and is currently on the educational affairs committee of the Muncie Chamber of Commerce.

Albert Underwood, Jr., elected to the Board of Directors last April, is a past chairman of Windsor chapter. During his chairmanship ASTME's first Canadian student chapter was formed in Windsor. In 1959 Underwood served as program chairman for the Second Canadian On-Campus Conference, held at McMaster University in Hamilton. Now acting manufacturing manager of Ford Motor Co.'s Windsor manufacturing operations, he has successively advanced through various positions in that company since his graduation from their trade school in 1947. He has also attended Queen's University in Kingston, Ont. Underwood is now on the board of directors of the Victorian Order of Nurses in Windsor.

Willis J. Potthoff has served on the National Technical Publications Committee since 1953. After holding the chair of that group for two terms, he is currently vice chairman in charge of the textbook program. A past chairman of the St. Louis chapter, Potthoff was instrumental in the establishment of the first scholarship program there. He recently sponsored a series of meetings with industry in his community to review the six sections of the proposed tool design textbook. Also active in other societies, Potthoff heads the ASM committee on punch press tools and is a member of the ASME committee B5. He is supervisor of tooling at the Electronics and Avionics Div. of Emerson Electric Mfg. Co., St. Louis.

Robert M. Johnson, now chairman of the National Membership Committee, was previously an area captain and vice chairman for that group. In the Twin Cities chapter he has filled the offices of program chairman, treasurer, secretary, second vice chairman, first vice chairman, chairman and chapter delegate. Johnson is currently supervisor of production engineering for Minneapolis-Honeywell's Temperature Controls Manufacturing Div. and its Die Cast & Plastic Molding Div. His civic activities range from the vice presidency of the local Lions Club to work with the Boy Scouts of America. Johnson attended the University of Minnesota, St. Olaf College and Mankato State Teachers College.

Dean Saurenman has spent two years on the Board of Directors, three years on the National Standards Committee and one year on the National Editorial Committee. In his home chapter of Houston, he has held every office except that of secretary. Saurenman served in key posts in the planning and executing of both National Conventions hosted by Houston. A development engineer for the Schlumberger Well Surveying Co., he is active in the Boy Scouts of America and was instrumental in his company's recent sponsorship of a scientific and engineering explorer scout post. Saurenman was graduated from the California Institute of Technology and has been a member of ASM for 20 years.

Duane H. Brighton, an incumbent director, was on the National Finance Committee for seven years, serving one term as chairman and two terms as vice chairman. He has also served on the National Nominating Committee and in his home chapter of Peoria has occupied the positions of chairman, national delegate, vice chairman, treasurer, student adviser and standards committee chairman. Brighton is a machine tool coordinator at Caterpillar Tractor Co., where he completed a four-year machinist apprentice course. In addition, he has studied at Bradley University and Alexander Hamilton Institute. Brighton is one of the organizers of the Illinois Council of ASTME.

James R. Matthew is chairman of the National Program Committee, which has claimed his service since 1955. He began his varied ASTME background in 1939 as a charter member of Peoria chapter. Next Matthew joined the St. Louis group of the Society, then became a charter member of Denver chapter, serving as secretary, program committee chairman and chapter chairman. At present he is a charter member of Tucson chapter, for which he acted as program committee chairman in 1953. A liaison and sustaining engineering for Hughes Communications Div., Matthew coordinates tooling, processing, purchasing and design problems between engineering and manufacturing operations.

Born Builder

By **Patricia Libel**
Assistant News Editor

OUTSIDE IT WAS WINTER, 1932. The scene was Detroit.

Inside an aging building—old enough to be minus a central heating system—six men sat round a stove, unaware of the wind, the frost and the cold. They felt only the warmth of excitement and dedication. They had gathered to discuss the formation of an American Society of Tool Engineers. One of the six—the man who called the meeting and held it in his office—was O. B. Jones. . . .

Jones is a hospitable, Virginia-born gentleman with an air of almost-old-fashioned charm. He is small in stature. He smokes a thin little pipe. He looks at the world through small, soft eyes that sometimes snap with merriment and sometimes withdraw in meditation. But O. B. Jones, father of ASTME and founder of Detroit College of Applied Science, dreams big and builds big.

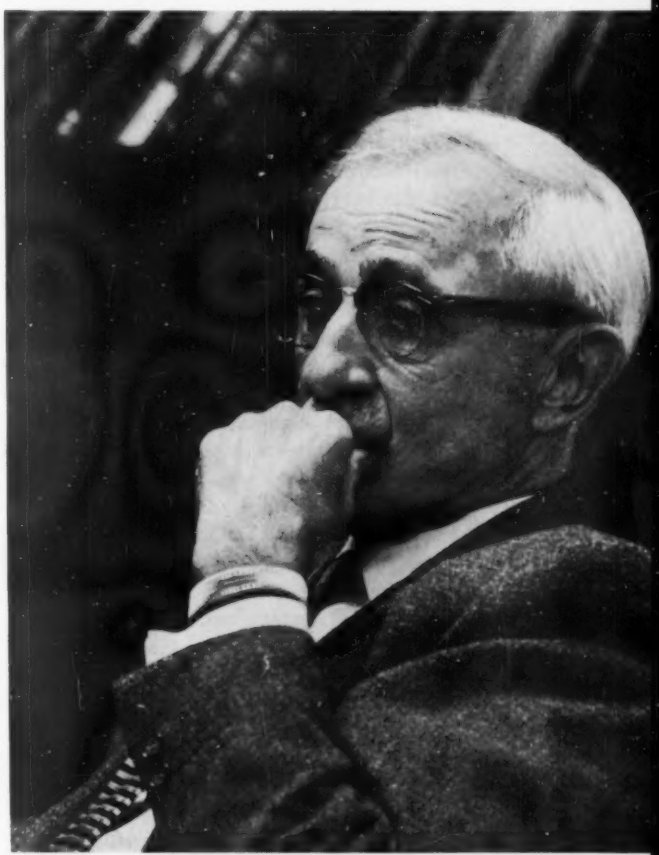
"You start building with a dream," says Jones.

He smiles when he recalls that he was once labeled "the dreamer" because of his big ideas about a great and strong society of tool engineers. He can afford to smile now—he has seen some powerful big dreams come true.

Beginnings of a Building

When the '20s began, Jones was a young electrical engineering graduate of Tri State College of Engineering in Angola, Ind. By 1926 he had been in charge of manufacturing operations and tool engineering for several corporations. And he had been in industry long enough to sight a need—a need in the realm of engineering education, a need for practical training that would make students immediately usable to industry and would teach specialized skills to men already on the job. The builder's chance to do something about this came quickly. His brother, a toolmaker for Studebaker Corp. in Detroit, asked Jones, then chief tool designer for the same corporation, to teach him mathematics and tool design fundamentals after working hours.

Jones consented and offered the attic of his home as a classroom for these after-hours sessions. Not



Part country gentleman and part rugged pioneer, O. B. Jones is a dreamer who makes dreams come true.

only his brother, but 12 other toolmakers showed up for the first class. The newly drafted teacher was surprised and elated, for here was the raw material with which to build.

And build he did. In the following months Jones established the Detroit School of Applied Science, terminating his career with the companies and corporations of industry to serve them as an educator.

For 34 years Jones has remained president of the school, which in 1928 became a college. In that time, more than 13,000 students have been benefited by his specialist training program. Taught by a faculty who come direct from industry, the program consists of a complete course in management and manufacturing engineering, which encompasses process, tool and production engineering. Jones and his faculty write most of the texts, which are continually revised to meet the ever-changing needs of industry.

Students attend DCAS full time for only one term. The next four years they spend working full time in industry and attending the college's evening classes. "This combination of education and practical application," explains Jones, "lets us produce an engineer qualified for the technical phases of his state certification in five years."

Link For Tool Engineers

But DCAS is not the extent of Jones' building. Soon after his transition to the world of education, he became aware of another need in industry—the need for a connecting link among tool engineers. "The lack of a central body coordinating the actions of scattered individuals and groups," he later wrote, "resulted in the duplication of effort that is so wasteful and contrary to the very religion of a tool engineer, which is summed up in one word—efficiency."

Thus in February of 1932 Jones called in other men from the tool engineering field to plan how the need could best be met. ASTE, formed with 33 charter members on March 3 of the same year, was the solution. The idea spread. It started an avalanche. The organization grew and grew and grew . . . to the present 40,000-strong, internationally known ASTME.

"I'm more proud of being connected with ASTME than with anything else," says the white-haired man who was so much a part of early ASTE days. "And standing back and watching it grow is what I've enjoyed most."

But in the early years of the Society he had no time for standing back. From the beginning Jones generously devoted his time and effort to the young organization's official publication, the *ASTE Journal*. After tirelessly working on the committee that put out the magazine during the first year of publication, he became editor of the Journal in 1933 and remained in that position for two years. From '32 to '37 he served on the Society Board of Directors and in '36 was appointed chairman of the National Historical Committee.

By action of the Board of Directors, O. B. Jones in 1939 became the third man to be elected to honorary life membership in the Society. In 1955 he received the Society's first Joseph A. Siegel Memorial Award as "a prime founder and leading spirit in organizing the Society . . . a most sincere educator in the development of young tool engineers . . . an unstinting contributor of his time, his abilities and his personal means to the Society's progress."

More Teacher than Tool Engineer

At heart, Jones is more educator than engineer. His eyes and words sparkle with enthusiasm when he talks of his students, his school or anything remotely connected with them. And he'll tell you quite frankly, "I'm more interested in people than in machines."

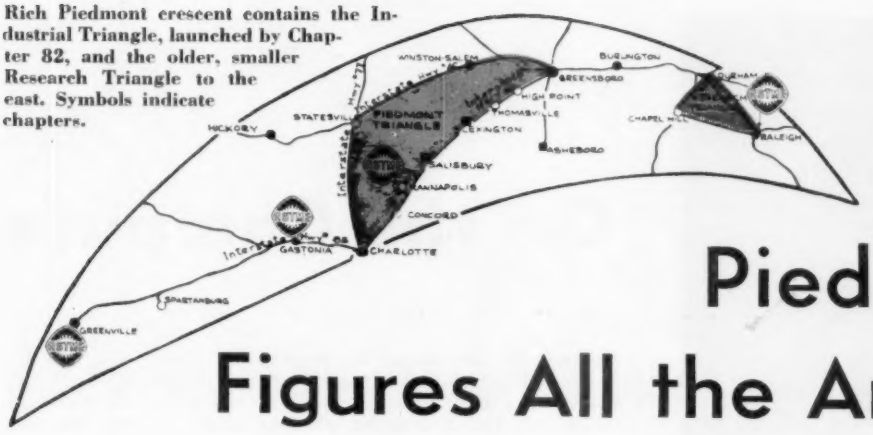
That's why he is so concerned about production-line educational systems. "Human beings are too diverse to be treated like products on an assembly line. At DCAS we try to uncover the talents each student has, to teach him to be creative and never to be satisfied with what he studies here."

Enthusiasm for DCAS has, quite naturally, rubbed off on Jones' family. His son is vice president of the college; his daughter is married to a former DCAS student, who is now first vice president of the alumni association. And by the way, grandfather, himself, has painted portraits of all the grandchildren.

At 66, the builder is still a-building.

His newest dream, when realized will be something new for the U. S., although it has been done at a college in Sweden. Jones envisions a complete factory entirely staffed and managed by students of DCAS. It will have all the usual division—personnel, sales, engineering, purchasing, and so on—and will manufacture a real product. According to Jones' plans, a student will apply for a job in this factory on coming to the college; he will make practical use of his classroom learning in the factory and before he is graduated will work his way from bottom to top, gaining actual job experience in every phase of factory work and management.

The experimental factory, insists Jones, will be his last major effort. He sees a long-looked-forward-to retirement in the not-too-distant future. What will he do then? Perhaps he'll devote more time to hunting bear and deer, or to painting landscapes, or to reading Longfellow, Shakespeare and Whittier. Certainly he'll go on dreaming and building—but on a slightly smaller scale than before.



Rich Piedmont crescent contains the Industrial Triangle, launched by Chapter 82, and the older, smaller Research Triangle to the east. Symbols indicate chapters.

Piedmont Figures All the Angles

NOWHERE IN THE COUNTRY—nay, not even in Texas—can one hear the hard sell delivered in softer accents than in the North Carolina Piedmont.

"The hard facts," soft-spoken promoters will tell you, "are that the Piedmont areas around Greensboro and Charlotte have a potential market value added by manufacturing of $2,355,000,000—greater by far than any other equivalent area in the entire southeastern U. S., and even including Texas.

"And nationally," conclude the dulcet hornblowers with a note of triumph, "the relatively small but enormously rich Piedmont industrial crescent ranks 19th in value added by manufacturing."

No one can gainsay the hard fact that North Carolina, and especially the Piedmont, have shown the South how to progress industrially. And it is a well-known fact among the people of Greensboro and Charlotte and Winston-Salem and Statesville and Salisbury, to mention some of the Piedmont's settlements, that Chapter 82 of the American Society of Tool and Manufacturing Engineers has contributed as much as any organization to this industrial and technological progress.

Piedmont chapter's latest contribution was made at its annual Executive Night held recently in the Salisbury Country Club. At the meeting the chapter announced its sponsorship of a Piedmont Industrial Triangle, a new concept of the state's growing industrial might.

Prompted by the success of the smaller Research Triangle which was launched by the state five years ago, the ASTME group found some eye-catching industrial geography right under their noses. They noticed that three interstate highways form a triangle in the heart of the Piedmont crescent, and that the triangle abounds in complex industries such as metalworking, electronics, missiles and plastics. From the triangle also are drawn most of the 275 members of Chapter 82.

The chapter hopes to promote the Industrial Triangle—with Greensboro, Charlotte and Statesville at each apex—as the ideal place for such industries and their suppliers and services. The man who thought up the angles in the triangle was Sidney B. Jeffreys of Greensboro, past chairman of Chapter 82 and former member of the National Public Relations Committee.

One of the speakers at Piedmont's Executive Night, and one of those most impressed by the signs of industrial expansion that he saw on every hand, was ASTME President H. Dale Long. In an interview with the press before the Salisbury meeting, the Chicagoan declared that the area had much to offer the industries they are seeking to lure. Talking as the president and board chairman of a metalworking firm (Scully-Jones & Co.), Long said he thought many northern companies might benefit by setting up southern branches to manufacture their standard catalogue items, retaining their special items in the home plants.

Speaking as ASTME president, Long lauded the spirit of the area as exemplified by the mother chapter and the other chapters that it has spawned: Raleigh-Durham in 1956; Bristol, Va.-Tenn., and Gaston Tech student chapter in 1959; and Greenville-Spartanburg in 1960.

Chairman Harmon Shaw of Charlotte welcomed the guests and national officers, who included Vice President Frank Ford of Atlanta. Notice from National that a special award of merit had been made to the widow of Albert F. Moosbrugger was read. Moosbrugger, past chapter chairman, died Aug. 23, 1960.

Main speaker at Executive Night was William R. Henderson of Raleigh, industrial development administrator for the state.

Among the 200 at the Salisbury affair were civic and industrial leaders from nearly all the communities in the newly named Industrial Triangle. They joined with the host engineers in dedicating themselves to the proposition that—industrially, at least—there are no squares in North Carolina.

On the Campuses

National Director Duane H. Brighton of Peoria, Ill., and Dr. James H. Bell, director of guidance and navigation of the AC Spark Plug Div., pause to talk in the lobby of Marquette University's Union. Brighton was toastmaster and Bell was main speaker at the dinner climaxing the Wisconsin conference.

Conference Debut in Wisconsin

ONE HUNDRED FORTY REGISTRANTS at Wisconsin Council's first campus conference heard a forecast from one of the 16 speakers that template-making centers will arise and flourish in the next decade. Such centers, said Thomas T. Sergeant of the Machine Control Div., Minneapolis Honeywell Regulator Co., will fill orders from small plants who have tracer control equipment but who cannot afford the costs of complete numerical control systems.

"It's not always a case of hanging a lot of black boxes on an existing machine," he said. "Numerical control retrofit is a touchy subject, and small firms should realize this before they invest."

Theme of the conference, held in the new Union at Marquette University in Milwaukee, was "Tooling for Small-Lot Production." The economics of such tooling was the province of Harry Conn, chief engineer of Scully-Jones & Co., who elaborated on his thesis that "most people are seeking more tool life when the intelligent thing is to seek shorter tool life." Other lectures included Robert L. LeMaster, Nelson Pattern Co., on advantages of plastic tools for small-lot production; Nick Bereznoff, A. C. Spark Plug Div., GM, on steel rule dies; and, at lunch, Dr. A. Bernard Drought, Marquette's engineering dean, on "Manufacturing Engineering—A Creative Profession."

Dinner speakers included National President H. Dale Long of Chicago and Dr. James H. Bell, A. C. Spark Plug, talking on "Industry and the Missile Age." ASTME Director Duane H. Brighton was toastmaster for the banquet; National Education Director Gilbert E. Seeley acted as toastmaster at the noon session. Presiding at technical sessions were John W. Kellogg, Racine, chairman of the state ASTME council; Ralph L. Perlewitz, Milwaukee chairman; William W. Warren, Fond du Lac chairman; and Roy A. Lindberg, University of Wisconsin professor and chairman of Madison chapter. Joseph Mundbrot, Milwaukee, member of the National Professional Development Committee, was general chairman of the conference.

Three key figures in the Wisconsin On-Campus Conference found the program going smoothly when they took stock at noon. Standing is Joseph Mundbrot, conference chairman; seated are Dr. A. Bernard Drought, engineering dean at Marquette, and Ralph L. Perlewitz, Milwaukee chapter chairman and secretary-treasurer of the Wisconsin Council.

Automation Is Mississippi Theme

COST REDUCTION through automation was the theme of a tool engineering seminar sponsored by Mississippi Chapter 141 and Mississippi State University. Held on the campus in Starkville, Miss., the seminar attracted over 100 tool and manufacturing engineers plus several hundred students.

Twenty-two speakers participated in the two-day program. Keynoter was ASTME President H. Dale Long, who pointed out that engineering seminars are one of the most important ways for tool and manufacturing engineers to keep up-to-date in a world of increasingly complex technological developments. Dr. D. W. Colvard, president of Mississippi State, stressed the impact of seminars on the rapid industrialization of Mississippi, which is changing over from an almost purely agricultural economy to one that is a well-balanced mixture of agriculture and industry.

Some of the technical subjects covered were numerical control (N. P. Sikich, Kearney & Trecker); cost savings through retooling (Robert J. Lawrence, Ingersoll-Rand Co.); design techniques for precision machine tools (J. Nitkiewicz, Ex-Cell-O Corp.); automatic parts handling (Alfred H. Brush, Syntron Co.); human relations and automation (Dr. Frank Bainbridge, Southern Research Associates); and education for automation (T. W. Black, THE TOOL AND MANUFACTURING ENGINEER).

The advent of computers for manufacturing control was explained by members of a four-man panel: Dr. J. C. McKee, Robert D. Guyton and Fred Davis of the university staff and Gus L. Baurnfind, Richardson Scale Co.

Another four-man panel covered management aspects of cost reductions. Panel members were H. C. Yaeger and John H. Handley, Vickers, Inc.; W. D. Ligon, Westinghouse Electric Corp.; and Frank E. Cotton, Jr., Mississippi State University.

Capt. Kenneth M. Tebo, U. S. Navy, was feature speaker at a special dinner meeting. His topic was the importance of Polaris to the free world.

Arrangements for the seminar, which has become an annual affair, were jointly handled by Frank E. Cotton, Jr., assistant director of the university's Engineering Extension Service, and M. I. Sappington, education chairman of Chapter 141.

Sacramento Holds First Conference

Chapter 145's first on-campus conference drew 65 to Sacramento State College to hear half a dozen lectures on "Manufacturing With Space Age Metals." Pictured here, looking at one of the exhibits complementing the conference, are William Wingenbach, college coordinator; J. B. Fletcher, chapter first vice chairman; Ken F. Keppeler, conference chairman; and Pete Nelson and Paul Smith, U. S. Gypsum sales engineers.

Members in the News

K. Albert Miegl

Arkla Air Conditioning Corp. of Evansville, Ind., and Little Rock, Ark., has announced the promotion of K. ALBERT MIEGL, Evanston chapter, to chief engineer. He had been major development engineer since joining Arkla in 1958. A registered professional engineer in the state of Indiana, Miegl was employed by Electronics Research, Inc., as an electronics engineer from 1949 to 1956, and the following two years he served Chrysler Corp. as a plant electrical engineer.

K. N. KRECKE, Detroit, has been appointed manufacturing manager for Ford Motor Co. stamping plants, to direct operations of the Metal Stamping Div.'s four manufacturing plants in Dearborn, Buffalo, Chicago and Cleveland and the Dearborn tool and die plant. Krecke has been with Ford since 1951, working as manufacturing staff assistant in the Engine & Foundry Div., later holding the positions of production manager and, beginning in 1955, plant manager of the Dearborn engine plant.

In announcing the appointment of GEORGE T. MORRIS, Philadelphia chapter, as vice president of Ray H. Morris & Co. of West Hartford, Conn., this magazine erroneously identified Morris as the son of the firm's president. A veteran of 17 years as sales and field engineer, Morris is the younger brother of Ray H. Morris, the president of the firm of machine service specialists. The elder Morris is a past national president of ASTME and a member of Hartford chapter.

K. N. Krecke

David P. Ebaugh

Automation Products Div. of Nytronics, Inc., formerly known as Sutton Electronic Co., has announced the appointment of DAVID P. EBAUGH, Lexington, Ky., to chief of the Industrial Engineering Dept. Ebaugh will be responsible for setting up the company's production and development programs for several new product lines, including constant voltage output transformers and cable assemblies.

PAUL E. DILLBERG, past chairman of Hartford chapter, has been named sales manager of the Skinner-Horton Chuck Div. of Skinner Precision Industries, Inc., New Britain, Conn. Dillberg has been associated with the chuck industry for over 20 years.

W. F. and John Barnes Co. of Rockford, Ill., has disposed of its interests in Metal Cutting Tools, Inc., to WILLIAM W. BARTON and BRUCE G. MILLER, Rockford member. Announcement of the new ownership of Metal Cutting Tools was incorrectly made in the November "Members in the News."

Hamilton Watch Co. has established a new Metals & Electronics Div., appointing LEON A. HURWITZ, Greater Lancaster, as director. Hurwitz joined Hamilton in 1947 as a project engineer and ten years later was appointed product manager of the Precision Metals Div., which position he held prior to his recent promotion.

JACK T. WELCH, Dayton, who has been associated with The Sheffield Corp. since 1942 in various capacities, including divisional vice president of the Machine Tool Div., has been transferred to Bendix International, New York, where he will become director of industrial marketing for the division. Sheffield is a subsidiary of Bendix Corp.

Adelaide Becomes Third ASTME Group in Australia

ADELAIDE, Australia—Getting together to exchange pointers at the charter meeting of Adelaide Chapter 169 are (left to right) Secretary E. J. Headland of Melbourne chapter, Secretary D. Corbett of Sidney chapter and Secretary J. W. Pulford of Adelaide chapter. The third ASTME group to be formed in Australia, Adelaide chapter was recently launched with 84 charter members. Attending the chartering, held in Edwardstown, were delegations from the Sidney, Melbourne and Ann Arbor chapters as well as representatives from the Australian Institute of Management, Institute of Technology and Chamber of Manufacturers. F. D. Rail, Windsor chapter chairman, served as chartering officer and presented the chairman's pin to Adelaide's W. H. Carlier. Other officers installed at the meeting were A. F. Frost, first vice chairman; H. J. Waters, second vice chairman; H. Stuart, third vice chairman; G. A. Meeks, assistant secretary; and C. T. Crowle, treasurer. —*J. W. Pulford*

Loan Fund for Students Commemorates Chapter Leader

BUFFALO—Chapter 10 has presented a $500 "Arthur Thormahlen Loan Fund" to the Erie County Technical Institute. The gift is an expression of the chapter's high esteem for the late Art Thormahlen, a former E.C.T.I. instructor who was chairman of Buffalo-Niagara Frontier chapter at the time of his sudden death in 1959.

The presentation was made at a meeting of the technical institute's ASTME student chapter—and fittingly so, since Thormahlen was instrumental in that chapter's formation. The school was presented with a plaque commemorating the award and a portrait of Thormahlen. Mrs. Thormahlen received a duplicate of the portrait of her husband.

This memorial loan fund is the second of its type to be installed by Chapter 10. In 1957 a $500 loan fund was set up in memory of Harvey Ellis. Both funds are administered by Erie County Technical Institute and are used to help students in need of financial assistance to continue their education.

At the presentation meeting, newly elected student chapter officers were installed by William J. Iskel, member of the National Membership Committee. Dr. Sidney Farnes, director of creative education at the University of Buffalo, spoke on "Creative Thinking." —*James E. Ingraham*

Rochester Speaker Stresses Need for Apprentice Programs

ROCHESTER—"Engineers need toolmakers and toolmakers need engineers. Let's train them both," urged Volkert Stampings' President Jack Kleinoder as he told 95 members and guests of Chapter 16 about the need for apprenticeship training programs. The talk emphasized that not only more, but better, machinists and diemakers are needed if American progress is to continue.

Kleinoder brought out that management of small tool and die shops, as well as large corporations, share the responsibility of maintaining skilled trades through apprenticeship training. As of Jan. 1, 1960, noted the speaker, there were in the United States 100,000 young men registered in apprenticeship programs. He estimated that there should be 700,000 young men in training to meet our growing needs and maintain skill crafts in the metalworking industry. —*O. E. Hosford*

special events

ASTME Seminar "Quality Control"	Jan. 11-12, 1961	Chase-Park Plaza Hotel, St. Louis, Mo.
ASTME Seminar "Machining and Forming Space Age Metals"	Jan. 18-19, 1961	Statler Hilton Hotel, Dallas, Tex.
ASTME 29th Annual Meeting	May 20-26, 1961	Statler Hilton Hotel, New York City
ASTME 1961 Tool Show	May 22-26, 1961	New York Coliseum, New York City

Ocean-hoppers Size Up European Industry

DETROIT—Departing for a two-week European trip, 30 members of Detroit and Macomb chapters, plus six guests, bid good-by to the good old USA. The group recently returned from their tour—loaded with interesting observations about European industry. "If world prosperity continues," said one member, "a lot of work now being done by European firms will be brought over here." Evidence of this: one Detroiter returned from the trip with 30,000 hours of design work from a British firm. Other members of the group noted that most machinery seen was European-built, but of American design; that European equipment and techniques are comparable to ours; and that investment per productive employee in Europe is not as high as in America because fewer fringe benefits are paid. The American visitors, hosted by the Gauge and Tool Makers Association of Britain, toured such British plants as Austin in Birmingham, Rolls Royce in Derby, Ford in Dagenham and the Caterpillar plant in Glasgow. In Paris the party visited the Simca plant as well as the International Auto Show. The success of the tour, organized by William E. Germani and Wayne Kay, has prompted plans for another trip to Paris, Germany and Switzerland next fall. It will be a "bring your wife along" tour, say the chapters.

Automation Wonders Described at Indianapolis

INDIANAPOLIS—Machine tool manufacturers' constant efforts to create ever better products have produced automation wonders that come close to Aladdin's magic lamp in supplying all needs, according to Jay Smith, sales engineer for the Cross Co. Speaking at a recent technical session of Chapter 37, Smith told of "Five Types of Automated Machine Tools," with particular emphasis on the building-block design system.

An outgrowth of the search for flexibility in machine tools, the building-block concept serves two important purposes, stated Smith. First, it permits economy of manufacture in the machine tool builder's plant; secondly, in the customer's plant it permits a machine of considerable size to be lengthened, shortened or rearranged with a minimum of downtime and expense.

In a slide presentation Smith illustrated what can be accomplished by adding building-block components to a machine initially constructed on the building-block principle. He showed a machine that produced five pieces per hour, using a single spindle equipped with a quick-change tool chuck. A rebuild of the machine increased production to 30 pieces per hour by the addition of spindles and a manually operated index table. Another rebuild equipped the machine with two main columns, a power-operated index table and sufficient fixtures and spindles for a production of 60 pieces per hour.

Other types of automated equipment explained and illustrated by the speaker included: the pallet type transfer machine that returns the pallet for unload and reload; the straight-through machine that exhausts the finished piece onto a conveyor for transportation to the next process; and the sectionized machine that performs more than 550 operations.

Proudly displaying their bulletin to speaker Jay Smith (left) are two Indianapolis chapter members, H. T. Stanton (center) and James J. Denney.

The sectionized machine, said Smith, has facilities for the banking of a number of parts between its sections so that tool changes will not interrupt operation of the entire machine. When certain tools should be changed, toolometers automatically render that section of the machine inoperative at the end of a cycle.

Smith concluded by citing an example of the productivity opportunities made possible by automation and building-block construction: the recent design of a cylinder-block machine that contains enough components to make 77 individual single-station machines. *—James J. Denney*

Windsor Groups Hold Joint Meeting on Education

WINDSOR—Gathered for a joint meeting of Windsor chapter and Western Ontario Institute of Technology student chapter are (left to right) Ray Smith, Chapter 55 chairman; guest speaker Dr. Frank DeMarco, dean of Essex College; and Douglas Harwood, first vice chairman of Student Chapter 30. Speaking on engineering education, Dr. DeMarco stressed the academic responsibility of the university and the responsibility of industry to supply the young engineer with practical knowledge. *—S. A. Hazen*

Knoxville-Oak Ridge Chapter Takes Trip Into Outer Space

KNOXVILLE-OAK RIDGE — Professor Roger Rusk recently piloted members and guests of Chapter 107 into outer space—via a slide presentation on the 200-inch Hale telescope at the astronomical observatory on Mount Palomar in California.

Rusk, who is associate professor of physics at the University of Tennessee, started the trip by showing pictures of the sun. The slides then wound farther and farther into outer space until the light-gathering power of the telescope had been reached. The slide depicting this outer limit, which is approximately one billion light years away from Earth, showed fifty galaxies the size of the Milky Way galaxy.

Professor Rusk's projector also gave the audience a return trip from the distant point in space. Earth's galaxy was seen, but its luminous center, which is characteristic of galaxies, is never visible because of the dark clouds of cosmic dust between Earth and the galaxy center.

In concluding, Professor Rusk posed an intriguing question: "What will man see in outer space when he can use telescopes that gather light from beyond the five billion light year range?"

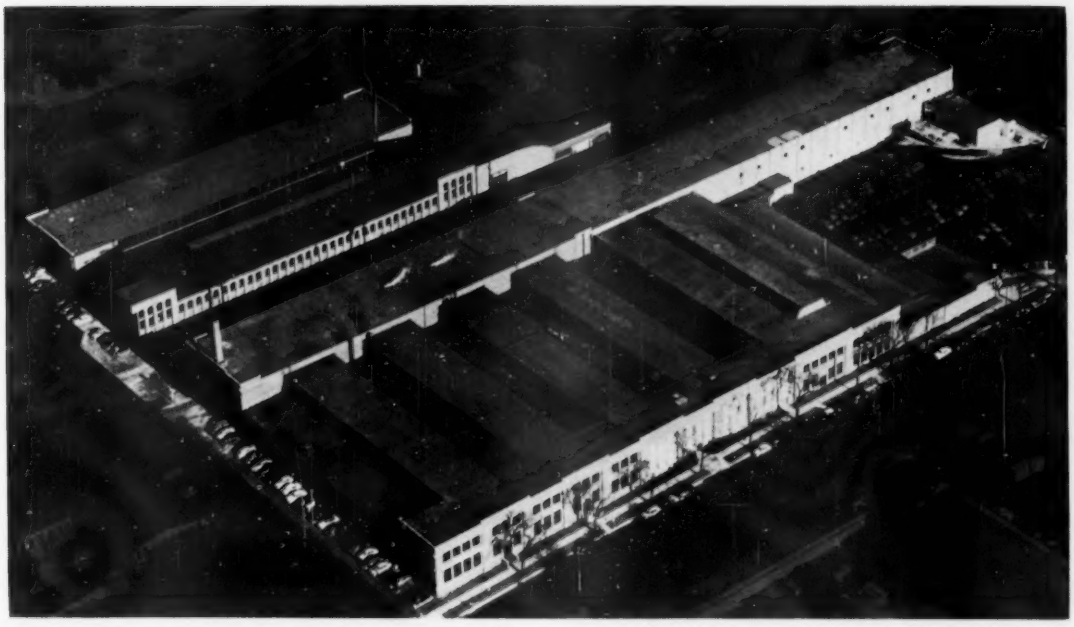
—R. D. Ellingson

Professor Roger Rusk uses a slide projector to conduct Chapter 107 on a tour of outer space.

Chapter Meets Under "Dawn of This Age"

DES PLAINES, Ill.—Beneath the three-stories-high display "The Dawn of This Age," in the DoAll Company's Hall of Progress in Des Plaines, Program Chairman Bernard F. Reilman conducts the monthly meeting of the Rockford chapter. The members traveled 100 miles in chartered buses to gather in this hall, which houses an unusual museum that delineates important events of the Industrial Revolution.

Chapter 11 Tours Plant, Hears About Polish Trade Fair



The D. W. Onan plant, Minneapolis, was recently toured by the Twin Cities chapter. The company, started in 1918, manufactures engines and electric generating plants for world wide distribution.

TWIN CITIES—A variety of products and processes were inspected by Chapter 11 members on their tour of the D. W. Onan Co., manufacturer of electric generating plants and engines. Of special interest to the ASTME group was the annealing of electric steel for rotor and stator laminations, accomplished by passing the steel through an induction heating coil on the punch press.

Twin Cities members learned through the tour that Onan is planning to manufacture a new line of engines to increase available power. The company now manufactures engines up to 15 hp. The new engines, called the J Series, will be available in air cooled or water cooled, gasoline or diesel models.

After the plant tour, the chapter held a dinner meeting, at which Jerry Formo, Minneapolis-Honeywell, told of his recent trip to the Polish Trade Fair as an official representative of the American plastics industry. The United States exhibit was set up to show the American way of life, said Formo, while the Russian display was entirely devoted to Sputniks. Formo also pointed out that most all machines in Polish factories are antiquated and inferior.

—Ed Gillaspy

University of New Hampshire Conference Covers Hydraulics—Pneumatics

GRANITE STATE — Left to right are the speakers at chapter 86's recent on-campus conference: Richard Wiley, education committee chairman; Mel Rutz, factory sales engineer at Aro Equipment Corp., Bryan, Ohio; Ted Sawa, sales manager at Hanna Engineering Works, Chicago, Ill.; Wesley R. Master, director of engineering at Dynex, Inc., Pewaukee, Wis.; and Robert Clay, chief engineer at Skinner Electric Valve Co., New Britain, Conn. *—Frank Moriarty*

Industry-Education Night Brings Challenge to Chapter 74

Chairman Cavalieri (center left) and W. Fitzpatrick (center right), program chairman, get together with Mid-Hudson chapter's Industry-Education Night speakers, Thomas L. Vinson (left) and Dr. James F. Hall (right).

POUGHKEEPSIE, N. Y.—Challenging manufacturing engineers to know their product and to keep abreast of rapidly changing technologies, Thomas L. Vinson, manufacturing engineering manager at the Poughkeepsie IBM plant, recently participated in a panel discussion at Mid-Hudson chapter's Industry-Education Night. The affair was attended by representatives from local industry and from the Poughkeepsie schools.

"The manufacturing engineer is of vital importance in product design," emphasized Vinson. "He must be familiar with manufacturing processes, knowing their limitations and capabilities. He must provide an economic balance to the development engineer, who is vitally concerned with function, quality and reliability."

The other member of the panel was Dr. James F. Hall, president of Dutchess County Community College. Speaking on "The Role of the College in Preparing Engineering Manpower for Industry," he advocated education in basic scientific and technical subjects as the groundwork for changing production requirements of modern industry. In the areas of specific technologies required for specialized production, Hall said, industry should do the training.

—E. R. Lang

Recent Deaths of Five Members Reported

FOND DU LAC, Wis.—Word has been received here of the death recently of Keith F. Gallimore, first chairman (1941) of Fond du Lac Chapter 45, and a former vice president and chief engineer of the Giddings & Lewis Machine Tool Co.

Gallimore died after a brief illness at Westerly, R. I. Born in 1885 at Burton-on-Trent, Eng., he came to the United States in 1907. He joined Giddings & Lewis in 1922 as chief engineer and became vice president of the company in 1935. Subsequently he was appointed to the firm's board of directors, retiring in 1956. He is survived by his wife Helen and a son. *—Oliver Wehner*

MACOMB COUNTY—A charter member of Macomb Chapter 142, Anthony A. Kasper, died Nov. 23 while on vacation in Reno, Nev. Kasper, 62, was owner-operator since 1942 of Kasper Mfg. Co., a tool firm in the Detroit area. He had been one of Macomb chapter's most loyal supporters since its inception in 1956.

BALTIMORE—Donald Wernz, chairman of Chapter 13 from 1953 to 1954, died on Nov. 14. Also active on the national level, Wernz served on the Editorial Committee in '55.

DAYTON—George W. Brandt, Jr., 44, past chairman of Chapter 18, died recently. He had been an active member of ASTME for 19 years. Owner of the Brandtool Co. in West Milton, Ohio, Brandt was a past president and treasurer of the Dayton chapter of the Society of Professional Engineers.

Another recent death in Chapter 18 is that of R. A. Gargrave, founder of Dayton Perforators, Inc. A senior member of the Society since 1949, Gargrave was also a member of ASM.

—Arthur MacArthur

Reports in Brief . . .

Northeast

Speaking before the PITTSBURGH chapter, Paul Carlan, a partner in Peter Muller-Munk Associates, dealt with the problems that confront both the industrial designer and the engineer in the adaptation of sound engineering principles to the design presented by the designer. Carlan also showed slides of products that his company has designed . . . . MOHAWK VALLEY TECHNICAL INSTITUTE student chapter recently journeyed to Sherril, N. Y., for a tour of the Oneida Limited plant. Here they saw how shiny silverware is turned out by automation . . . . Members of GREATER NEW YORK chapter learned of the intricate manufacturing process required to produce files when John D. Schmuhmann of the Nicholson File Co., Providence, spoke at their November meeting. Schmuhmann showed a film depicting the various files made for arts and industries . . . . Annual "Suppliers Night" drew 133 members and guests to a recent MONADNOCK chapter meeting. Twelve industrial suppliers from the area demonstrated their products before the group . . . . Alex Melnich, chief tool design engineer at U. S. Tool Co., Inc., Ampere, N. J., spoke on the "Multiple Slide Machine for Production of Stampings" at the November meeting of WORCESTER chapter.

Canada

The HAMILTON DISTRICT chapter held a combined "Past Chairman and Executive Night" at their December meeting. This month they are planning an "Education and Father and Son Night," at which President H. Dale Long will be speaker. The event is tentatively scheduled to take place on the campus of McMaster University in Hamilton . . . . Ray Ghent, manager of Brantford's Micromatic Hone, presented a paper on precision honing at a recent meeting of TORONTO chapter. The same evening Shell Oil Co. presented a film illustrating what happens to an aircraft in the transition stage between sub and supersonic speeds.

Midwest

In a slide film presentation, J. J. Pippenger, vice president of Double A Products Co., showed KANSAS CITY chapter members a variety of applications for machining parts with the use of hydraulic components . . . . Dr. John H. Hoagland, faculty director of the Michigan State University Purchasing and Materials Management Seminar, recently spoke to GRAND RAPIDS chapter on business trends . . . . DAYTON members heard Joseph W. Tierney explain the uses of epoxy resins in the tool and die field.

Australia

Meeting with the Sydney branch of the Institute of Production Engineers, SYDNEY chapter of ASTME heard an address by one of Australia's leading industrialists, James N. Kirby, C. B. E. The speaker stressed the need for training of future engineers and engineering managers, in view of the country's rapidly increasing work force. He also drew attention to the need for government review of the taxation policy on depreciation to assist industry in meeting the needs of mechanization.

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SALES AND DISTRIBUTION CONSULTATION—Consultation on sales and distribution available from team of widely acquainted former industrial sales managers. New products launched. Field organizations surveyed and reorganized. Market potentials evaluated. These are real pros, who can solve your selling problem. Write to Classified Ads, Dept. 194, 10700 Puritan Ave., Detroit 38, Mich.

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FROM ORE TO FINISHED PRODUCT WITHIN THE SAME COMPANY

Progress in Production

TWO NEW SPRAY GUNS GO TO WORK IN REINFORCED PLASTICS

With the advent of plastic spray equipment, reinforced plastic manufacturers are producing resin glass fiber products in less time and at a lower cost. The combination of spraying resin and fibers in one operation, however, requires high-cost production units, prohibitive to many smaller establishments where hand layup for prototype piece parts, short run work and semiproduction constitutes the daily workload.

To reduce the man-hours involved in the fabrication of polyester or epoxy laminates, U. S. Gypsum Co. developed a new spray gun that sprays polyester or epoxy resins having viscosities 50 to 6000 centipoises. With the gun, hand layup time is reduced as much as 40

Resin spray gun sprays epoxy laminating resin to bond metal fibers.

percent for some polyester piece parts and fabrication time for laminated epoxy tools is reduced as much as 60 percent. Operating at 50 to 60 lb air pressure and weighing only 1½ lb, the gun has a nozzle that permits the use of expendable cardboard resin container cups. The throwaway cups will hold from 8 oz to 2 lb of premixed resin.

Another new spray gun, developed by the same company, sprays metal fibers that serve as a mechanical fastener to bond an inexpensive gypsum backup material to an epoxy or polyester gel coat. The gun is used in a plastic-faced-plaster technique, which begins with the application of a gel coat to a previously lacquered and

Fiber gun sprays metal fibers on gel coat to bond backup material.

waxed mold. After the gel coat hardens, laminating resin is sprayed over the surface. Then the fiber gun is used to spray a 1/32-inch layer of ¼-inch aluminum fibers, which in turn are sprayed with a coat of laminating resin to bond them together. The metal fiber resin spray operation is repeated three times.

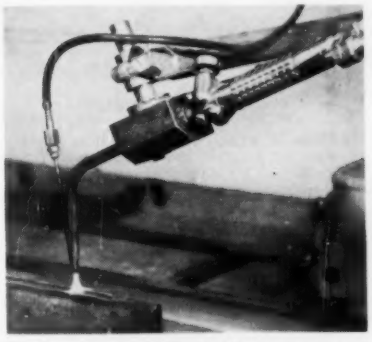
PROCESS SPRAYS, FUSES METAL ON METAL BY FLAME

Metal powders are sprayed and fused simultaneously on a base metal by means of an oxy-acetylene flame, using the Aircospray metal-to-metal surfacing process. Developed for hardfacing and brazing operations by the Air Reduction Sales Co., New York, the process can also be used for metal spraying solely and also for spraying subsequent to fusing.

Aircospray is well suited for hardfacing operations such as deposition of metal powders of a high-melting point, for alloys of greater hardness can be compounded in powdered form than in standard rod form. Capable of depositing bands of surfacing on thin and light members as well as on heavier sections, the process is used on pistons, valves, saw blade guides and any other sliding surfaces on engines, pumps or farm machinery.

When used in brazing operations with phosphorus or silver filler metals, Aircospray permits placement of the filler metal, combined with flux, directly on the joint area. This is useful in the fabrication of metal office furniture and sanitary joints for hospital furniture.

The basic element of the new process is a standard oxy-acetylene welding outfit with a modified torch tip that allows the metal powders to be sprayed



Torch tip simultaneously sprays and fuses hardfacing material.

through the oxy-acetylene flame. Additionally, there is a carrier gas source, a means of dispensing and carrying the metal powders to the torch tip, the necessary controls and a vibrator dispenser and flowmeter control, which eliminate caking and turbulence. The carrier gas flows at about 5 to 8 cu ft per hour and can be argon, helium, nitrogen or carbon dioxide. Either acetylene or natural gas is used as the fuel gas.

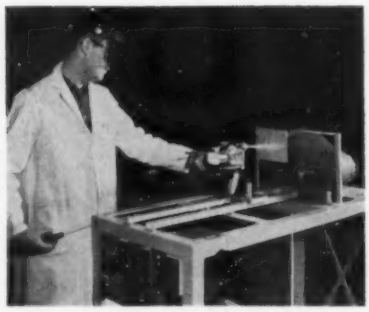
Simultaneously permitting passage of the oxy-fuel mixture and the metal powders into the flame, the specially designed torch tip has two separate channels to eliminate the costly problem of flashback. The tip is available in three styles and a total of 15 models.

FLAME-SPRAYING COATS METALS WITH ALUMINA

The National Bureau of Standards is investigating for the Air Force the basic principles involved in the flame-spray process of coating metals with alumina. Potential uses of the heat resistant coating produced by this process include the thermal protection of jet and rocket engine components as

well as regulation of temperature within space vehicles.

The bureau's study has demonstrated that the temperature and velocity of particles in the spray have an important influence on the characteristics of the resulting specimen. To measure particle velocities, a rotating-disk velocimeter was developed. The device consists of a 16-inch metal disk, a narrow metal strip attached at a known distance from the surface of the disk and a glass slide attached to the disk



Oxy-acetylene gun directs molten alumina particles against metal rotating-disk velocimeter, developed to measure particle velocities.

in such a way that it is partly shielded from the sprayed particles by the metal strip. When the slide is sprayed with the molten alumina, the strip creates a shadow in the layer of particles that adhere to the slide. The slide is first sprayed while the disk is at rest, then while it rotates at a known speed. The displacement between the two shadows formed on the slide is a function of the particle velocity.

Experiments on bonding suggested that the bond between the alumina coating and glass substrate is largely chemical, but that the bond formed between flame-sprayed alumina and metals is principally mechanical.

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1½" BAR AND COLLET WORK
CHUCKING
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Costs { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

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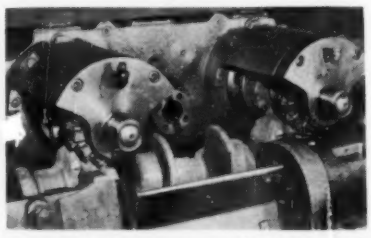
SPECIAL MILLING CUTTERS SAVE CRANKSHAFT COSTS

The first eight cuts on forged crankshafts spell the difference between good shafts and scrap. In cutting these locating spots, Studebaker-Packard, South Bend, Ind., uses half-side milling cutters to correctly establish the centerline of the shaft and locate all subsequent machining operations.

In the past, brazed inserted blade cutters were used for the operation. A year's production of 170,011 crankshafts then required 860 blades. Blade-grinding costs were high and blade breakage caused only 600 shafts to be produced with the average setup of four cutters and 40 blades.

Now half-side milling cutters with special parallelogram throwaway carbide inserts are used for cutting the locating spots. Grinding is completely



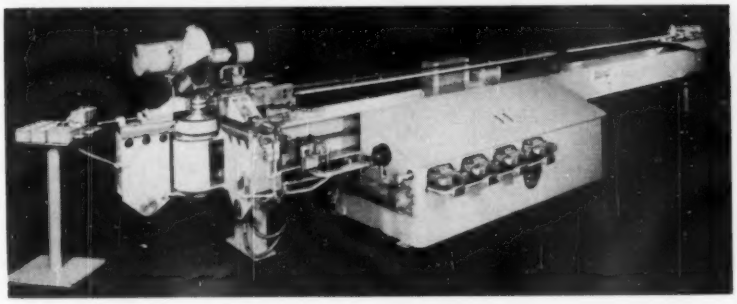
Rise and fall milling machine with right and left-hand half-side milling cutters straddle-mills locating spots.

eliminated, blade breakage is lowered because the number of teeth in the cutters is increased from 10 to 12, and the chip load is decreased because feed per tooth is reduced from 0.006 to 0.005 inch. Production averages doubled to 1200 per setup and 4800 per set of inserts.

The use of these special throwaway insert cutters, made by Wesson Co., allows an annual saving of $6093.99 in tool and grinding costs. In addition, one man is freed for other duties in the grinding department.

TOOLS of today

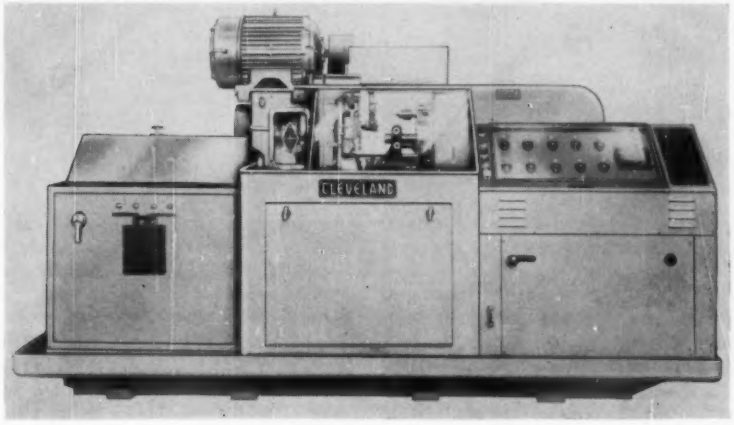
Rotary Type Hydraulic Tube Bending Machine



No. 500 rotary type hydraulic bending machine automatically feeds, bends, cuts and recycles. The machine accepts stock lengths to 20 ft and can bend to 180 deg if desired. It can bend one tube of 1⅝-inch OD, 0.083-inch wall copper tube or two tubes of 1⅛-inch OD, 0.072-inch wall copper tube. Completing its cycle in four seconds, it bends two tubes at a rate of 1800 pieces per hour or one tube at a rate of 900 pieces per hour. A steel carbide tipped blade is used to cut nonferrous materials and an abrasive wheel is used for steel. The machine has a 10-hp motor and a 15-gal pump.

Wallace Supply Mfg. Co., 1304 Diversey Pkwy., Chicago, Ill. **Circle 401**

Single Spindle Bar and Chucking Machine



By substituting a chucking attachment for the bar feed assembly in the spindle, the Model AB 3-inch single-spindle automatic machine can be converted from bar work to a chucking machine. It has a feed monitor dial which indicates turret tool feed rates in inches per minute for each of the five forward and return settings of the turret tools. Ten different infinitely variable feeds, adjustable while the tools are cutting, are possible in one cycle. There are five turret tool positions. The machine has 112 spindle speeds, ranging from 24 to 1820 rpm. A two-speed motor and friction clutch provide four automatic speed changes. The machine can work pieces up to 6 inches in diameter.

Cleveland Automatic Machine Co., Cincinnati, Ohio. **Circle 402**

Leadscrew Backlash Eliminator

Designed for use in screw-driven machines and mechanisms, this hydraulic take-up screw nut eliminates backlash. The nut also provides a continuous braking force and securely locks the elements in position when power is not applied. In the nut assembly, which consists of a pair of bronze nuts, hydraulic pressure is used to maintain contact between the nut and screw threads. One nut is locked; the other is forced in the opposite axial direction, thus exerting a wedging or preloading action upon the leadscrew.

Tracer Control Co., 595 E. Ten Mile Rd., Hazel Park, Mich. **Circle 403**

Control Maintains Preset Load

The Loadtrol provides a means of maintaining a preset load on the drive motor of process equipment, machine tools or web handling machinery. It can also be used to obtain maximum production from a crusher, saw, grinder, hammer-mill or pelletizer and to preset web tension in a press, converter or winder. The device senses motor load through a shunt or current transformer in the motor circuit and produces a signal which is matched against a control signal. If these two signals do not match, a command, pro-

portional to the error, is given to the Shaftrol actuator. This actuator may be mounted on a variable speed drive or on a valve or pressure regulator. Motors from fractional to several hundred horsepower can be controlled with the Loadtrol. It has a switch for manual control of the initial checkout and for establishing the desired set point. The Shaftrol can be shaft mounted and is easily adapted to most machines. It is offered in many sizes, speeds, torques, voltages and enclosures.

Jordan Controls, Inc., 3235 W. Hampton Ave., Milwaukee 9, Wis. **Circle 404**

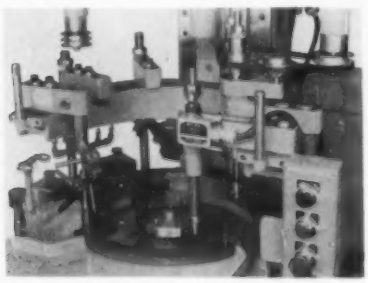
Sheet Metal Ductility Tester

The Ductomatic sheet metal tester, by simulating deep drawing press operations, provides a method for evaluating the ductility or forming quality of sheet metal. The unit has interchangeable plungers and dies which enable it to perform indentation, deep draw cupping and hole expansion tests. It can also be used to determine optimum clamping pressure and for electrical lacquer tests for studying the adhesion and flexibility of lacquer or paint finishes. The unit has infinitely variable hydraulic clamping pressure which is indicated, along with the depth of cup and load applied by the plunger, on one of several dials.

Tinius Olsen Testing Machine Co., Willow Grove, Pa. **Circle 405**

Inverted Spindles

Designed for dial type machines, these inverted countersinking and chamfering spindles are especially suited for small runs of stamping requiring secondary operations. They are adjusted in the same way as a cutting tool in a lathe tool post. The spindle itself is a cartridge powered



by a flexible shaft drive. The depth of cut is set by a micrometer adjusting screw.

Bodine Corp., 317 Mountain Grove St., Bridgeport 5, Conn. **Circle 406**

High-Speed Toggle Clamp

This Model 830 toggle clamp, with a rated holding pressure of 2500 lb, is designed for push and pull operation and fast holding action. It weighs 6 lb, 6 oz and has a clamping pressure (air or hydraulic) of 300 lb. Its forged

steel base is mounted on a steel plate. Over-all length in a forward position is $13^{15}/_{16}$ inches, width is 3 inches and distance from the bottom of the base to the plunger centerline is $1^{1}/_{16}$ inches. The plunger is tapped for $^{3}/_{8}$-16 adjustment spindle.

Detroit Stamping Co., 330 Midland Ave., Detroit 3, Mich. **Circle 407**

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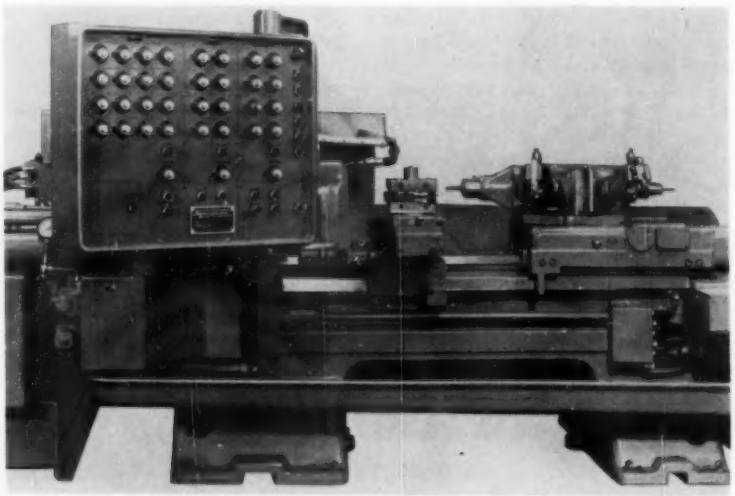
Tapeless Numerical Machine-Tool Control System

Full numerical positioning control plus complete manual adjustment for error correction, tool wear or material variations are possible with the Specialmatic machine-tool control system. No external programming of tape or cards is required. In effect, the turret lathe is converted into a single-spindle automatic for short runs.

Point-to-point rectilinear control of feed rates and dimensional end points at the control panel on the machine tool, plus a built-in logical programming system, enable a setup man to work directly from the numerical



dimensions on the blueprint. Familiar machine-tool setup procedures are used and all programming functions are labeled in the machinist's language. Operator training time is about four hours.

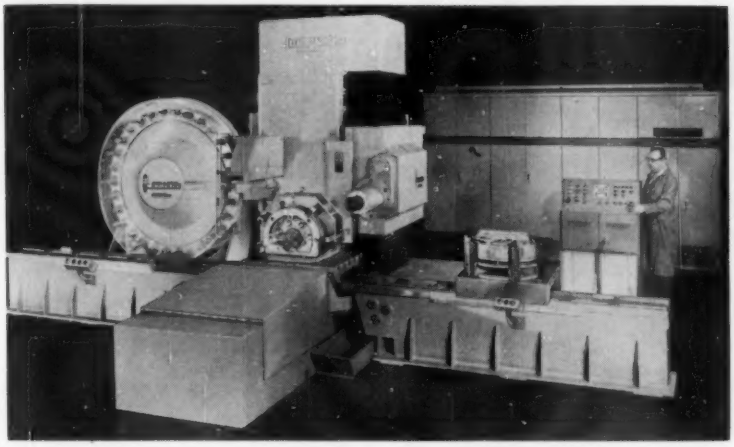
A complete set of stainless steel keys is supplied with each system. Each key in a set is preperforated in a binary pattern to provide logical control of up to three operations or auxiliary functions. For a required setup, the correct keys to program the necessary sequence of operations are selected from the set and inserted in a programming drum mounted in the control panel. Perforation patterns in the keys are read into the system by photoelectric cells. Because there are places for 36 keys on the reader, 108 operations of 63 different types are provided and can be used in any desired sequence.

With the functional sequence programmed, end points and feed rates are individually set for each required dimension by one of the dials on the control panel. Any correction or adjustment of dimensions that appears necessary during setup or production can be made by dialing in the correction on the dial which controls the inpoint for that particular dimension.

The heart of the control system is a sequential, linear-positioning transducer. Its positioning accuracy is better than 0.0002 inch under shop conditions. Each controlled motion is fitted with one of these transducers to feed back a signal that reports its position at all times. Numerical input to the control is by individual dials calibrated in divisions of 0.001-inch.

Specialities, Inc., Skunks Misery Rd., Syosset, L. I., N. Y. **Circle 408**

Tape-Controlled Manufacturing Center

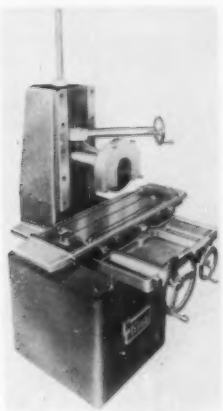


This machine unifies milling, drilling, boring, reaming, tapping and other related operations into a single tape-controlled manufacturing center. It has a 30-tool automatic tool changer magazine which can make changes in 15 sec. Total spindle movement includes 44 inches in depth axis. A 15-hp spindle drive motor provides powder from 50 to 2000 rpm in 10-rpm increments. Feed rates range from ½ to 49 ipm in ½-ipm increments and the rapid traverse rate is 150 ipm. The rotary table automatically indexes 360 deg in 1-deg graduations.

Kearney & Trecker Corp., 6800 W. National Ave., Milwaukee 4, Wis. **Circle 409**

Extra Capacity Surface Grinder

This manually-controlled surface grinder for either wet or dry grinding has a longitudinal table travel of 20 inches and a 14-inch crossfeed. It has a 12-inch-diam grinding wheel and a 15-inch vertical clearance over the table. When used for wet grinding, the working surface is 10 x 20 inches; for dry grinding, 12 x 20 inches. The Model K-1020 machine has a direct-drive

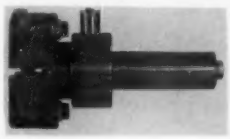


spindle, rotating on ball bearings, and is powered by a 1½-hp balanced motor. The spindle operates at speeds to 1725 rpm.

King Machine & Mfg. Co., 1171 E. 32nd St., Los Angeles, Calif. **Circle 410**

Adjustable Tap Holder

This 1½-inch capacity combination releasing and nonreleasing completely floating adjustable tap holder can be used on both turret lathes and automatics. A half turn of the tripping dog in the reversing mechanism changes the direction of the tool instantly for



right or left hand tapping. Independently mounted sliding jaws are utilized which provide four and five-point holding and move in a vertical direction to accommodate 7/16 to 1½-inch tap sizes. The shank size is 1½ inches. No bushings, collets or extra jaws are required.

RoyEL Tools, Inc., P. O. Box 7486, Minneapolis 22, Minn. **Circle 411**

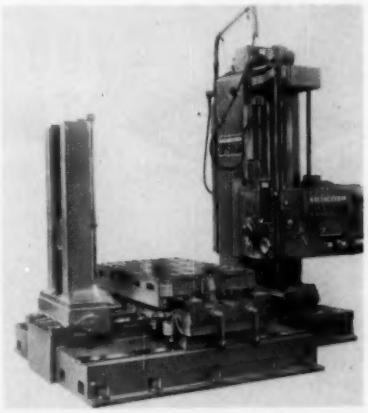
Cutting Tool Carbides

Five grades of cemented carbide have hardnesses ranging from 91.2 to 93 R_A and transverse rupture strengths from 225,000 to 325,000 psi. N-20 is used to machine cast iron and nonferrous materials. N-50, for heavy cuts on steel, has good resistance to mechanical and thermal shock as well as good wear resistance. Having less shock resistance but greater wear resistance than the N-50 grade, N-60 is for general purpose machining of steel. N-70 is a finishing grade for moderate cuts at high speeds and N-80 is a finishing and boring grade with good wear, crater and thermal shock resistance.

Newcomer Products, Inc., Latrobe, Pa. **Circle 412**

Building Block Boring Mill

Designed on the building block principle, the illustrated 4-inch spindle table type horizontal boring, drilling and milling machine is offered in an almost unlimited combination of table, saddle, bed and column sizes. It is suited for numerical positioning control and numerical contouring and can also utilize tracer controls. The machine may be supplied with vernier measuring, optical measuring, rod and



dial indicator measuring or automatic positioning of the head, table and saddle. Electromagnetic feed and drive clutches are shifted hydraulically by rotary selector valves mounted on the head. The machine has 27 spindle speeds, 12 spindle feeds and 24 feeds to the saddle, head and table. Powered by a 20-hp motor, it also has three pairs of gears driving in the high speed range. An adjustable-depth dial, graduated to either 30 or 36-inch spindle travel, includes a kick-out for spindle feed. A feed handwheel graduated to 0.001 inch is geared into the depth dial. The machine shown—Model F—has a 92-inch long saddle and a 38 x 40-inch table.

Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio. **Circle 413**

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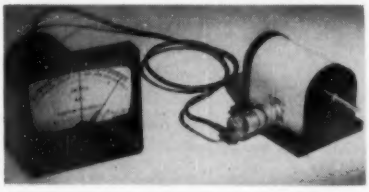
TOOLS of today

Monitoring Unit for Machine, Gage Automation

Suited to measuring deviations of a few thousandths of an inch from mechanical null, this linear transducer can be used with a panel meter if a signal indication only is desired or with a meter-relay if an operation is to be controlled. Applications of the latter combination include testing parts for oversize or undersize, indicating linear oscillation of a shaft, automat-

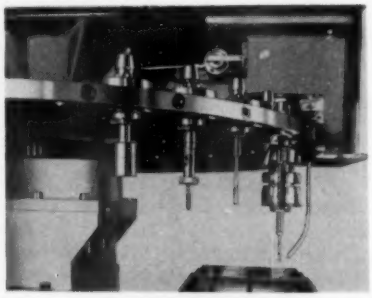


ing machine tools, measuring pressure from diaphragm movement and measuring depth of applied coatings. Sensitivity is ±0.005 inch and maximum readout speed is 1 sec. When a constant voltage transformer is used, full meter accuracy is ±0.0002 inch and reproducibility is ±0.0001 inch.

Assembly Products, Inc., Chesterland, Ohio. **Circle 414**

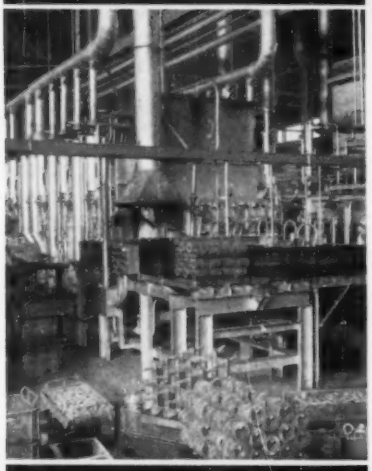
Tape-Controlled Multipurpose Machine

Designed for numerical control, the Spindlemaster can drill, tap, bore, ream or mill. The three axes, single spindle and compound table are controlled by tape commands, as are 18 spindle



speeds from 150 to 3125 rpm, 98 spindle feeds from 0.4 to 19.8 ipm, spindle and table traverse and the coolant cycle. The machine's 30-tool changer makes changes in less than 8.5 sec. The table and carriage are mounted on an adjustable knee with twin raising screws. The table has 8 inches of vertical adjustment in one-inch increments. Specifications of the machine include

HOLCROFT



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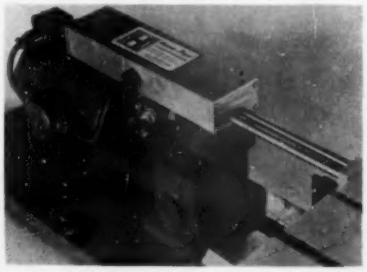
9.999 inch spindle travel; 30x16-inch table size; 24 x 16-inch table travel; 18-inch maximum turret-to-table part clearance; 18½ x 30 x 16-inch wide maximum part size; and 4-inches maximum tool diameter.

Cleereman Machine Tool Corp., 7350 W. Lawrence Ave., Chicago 31, Ill. **Circle 415**

Multiple Positioner

The Hanna-Powr positioner, an electrical-mechanical servo device, automatically positions machine tool slides, valves, float levels, doors, hoppergates, etc., at any of several predetermined positions. The device is available with as many as 14 sets of limit switches per foot, giving 14 different positioning stops per foot. The location of the predetermined stop position stations



can be easily changed by loosening two adjustment screws and moving the switches. The positioner achieves accuracies of ±0.005 inch. With a two-directional motor and a reversing relay, it can also be used to operate many different types of devices. The limit switches are rated at five amp but may be used at 15 amp with reduced life.

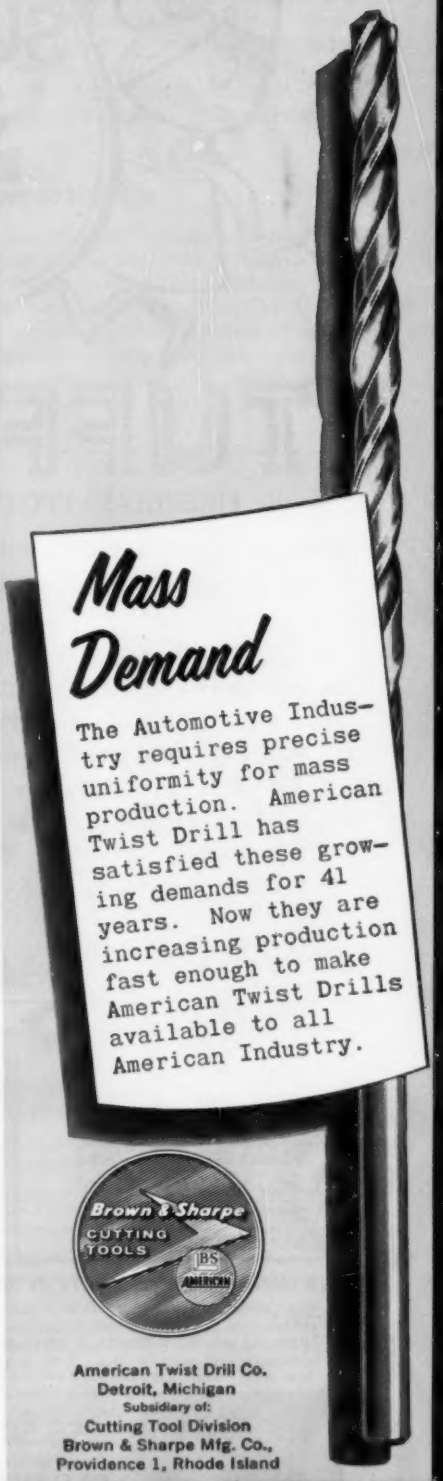
Hanna Engineering Works, 1765 Elston Ave., Chicago 22, Ill. **Circle 416**

Grinding Machine Vibration Monitor

Sensitive to vibrations as small as 0.000002 inch amplitude, this electronic resonance type vibration monitor can be used to flash a signal or to stop a machine if preset safe limits of vibration are exceeded. It has tunable pickup which filters out extraneous vibrations through mechanical reso-

nance. By use of a channel scanner which feeds information transmitted from each bearing by individual pick-ups into the monitor, the vibrations of several bearings or units can be read

AMERICAN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* 20,000 psi COMPRESSIVE STRENGTH
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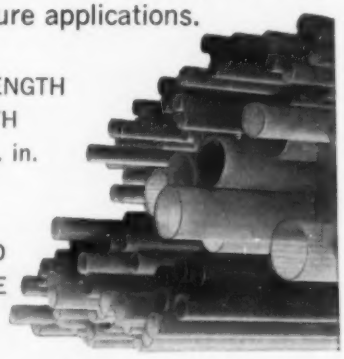
* SMOOTH SURFACES
* EASILY, ACCURATELY MACHINED
* TOUGH, ANTI-WEAR LAMINATE
* RESISTS HIGH TEMPERATURES



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.512 x .562	.56	.52	.48	.44
.884 x .950	.67	.62	.58	.53
.905 x .950	.67	.62	.58	.53
.920 x 1.000	.68	.63	.59	.54
1.000 x 1.093	.70	.65	.60	.55
1.250 x 1.344	.99	.92	.85	.78
2.662 x 2.750	1.65	1.53	1.41	1.30

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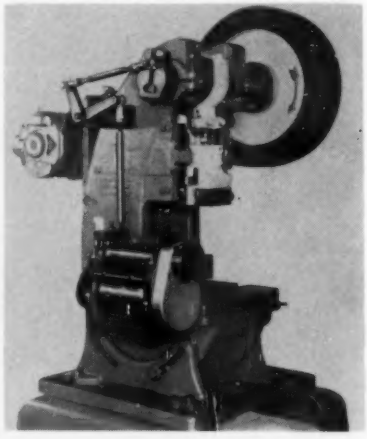
TOOLS of today

at the same time. Especially applicable to grinding machines, the device keeps wheel vibration down to acceptable levels so that finer finishes and tolerances can be obtained. With an accessory plug-in attachment, the device becomes a portable balancer for correcting the condition creating the vibration.

Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14, Ill. **Circle 417**

Roll Feed

Series 3.5 roll feed incorporates a cam clutch, adjustable roller pressure, a brake to prevent coasting, a roll lifter, needle bearings on rollers, a reversible clutch, stock guides and an adjustable mounting bracket. The lower



feed roller is 3⅞ inch in diam and produces a nominal 3½-inch stock travel with less than one-third of the full roller circumference. No gearing is employed. Two series are available both having rollers to handle, 3, 5, 7 and 9-inch stock widths.

Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif. **Circle 418**

Blades for Throwaway Milling Cutters

Throwaway insert carbide milling cutters with one of these microfinishing blades give surface finishes consistently below 50 microinches rms. Designed for use with cam pin design, the blade is inserted in the slot with the least amount of runout so that it can be positioned anywhere within the adjustment range (0.030 inch) of the

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cam pin. Its cutting edge is parellel to the cutter flange where it wipes away cutter marks. The blades are available in five carbide grades for cam pin cutters using ¾-inch square throwaway inserts.

Wesson Co., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 419**

Stub Boring Tool Sets

Three stub boring tool sets consist of a combination of tools for meeting most requirements in a range from 7/16 to 18 inches. All three sets contain micrometer-adjustable flycutter bars and tooling. They have bar diameter-to-length proportions for maximum cutting performance and can use SHSS, TCT or throwaway insert cutters. Continuous feed heads for boring, facing, turning, counterboring, backfacing, grooving and chamfering operations are included in the two larger sets. All sets are available with Morse taper, milling machine taper or quick-change shanks.

Giddings & Lewis Machine Tool Co., Fond Du Lac, Wis. **Circle 420**

Deburring Machine

Capacity of the Model DB-1616 two-compartment barrel is 2 cu ft, each octagonal container measuring 16 x 8 inches. The barrels, lined with ¼-inch abrasive resistant plastic, are rotated by a ½-hp, 220/440 volt, 3-phase, 60-cycle motor. The machine is manually operated by a switch with overload protectors. Its speed is variable from 13 to 39 rpm. The "Space Saver" machine requires 4.8 sq ft of floor space.

Almco, Precision Finishing, Queen Products Div., King-Seeley Corp., Albert Lea, Minn. **Circle 421**

Miniature Air Switch

Pneumatic Model 103 S, a miniature air switch, is a magnet-actuated device measuring 1½ inches in length and ½ inch in diameter and weighing less than 2 oz. Designed especially for use in pneumatic circuits where a very low actuating force is available, the switch has no mechanical linkage or striking parts. It can be used in place of electrical components such as electrical devices in ordinary service as well as in areas where there is an explosion hazard. Features include snap action when energized or de-energized by a small magnet on a moving member of a mechanism, low air consumption and maximum pressure of 25 psi. Bleed rate is 0.05 cfm at 10 psi when de-energized and zero when energized.

Associated Control Equipment, Coraopolis, Pa. **Circle 422**

Facing and Boring Head

Internal and external boring, facing and back spot facing operations can be performed on all materials from gray iron to the exotic metals with this circular facing and boring head. It has a 3½-inch bore but can also

be sleeved or bored to fit other size spindles and boring bars. The unit, equipped with a reversing index lever, has ten adjustable feeds, both in and out, from 0.0025 to 0.025 inch. A hand-operated, direct-reading micrometer adjustor, graduated in 0.001-inch increments, permits slide settings from zero to 36-inch swing.

Keller Equipment & Mfg. Co., 2320 Military Rd., Buffalo, N. Y. **Circle 423**

Keyseater

Intended for cutting keyways from ⅛ to 2½ inches wide and up to 22-inch-long parts in both toolroom and low production operations, the Model 25 keyseater utilizes a double solenoid-operated four-way pneumatic valve and air cylinder hook-up to provide automatic work table backoff and feed. The

new

more power at the cutter!

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2-XH Milling Machines

PLAIN AND UNIVERSAL MODELS

The completely new GREAVES No. 2-XH Milling Machine brings added versatility, increased operational ease, and more power where it's needed most . . . *at the cutter!*
It utilizes two motors, one for spindle drive; a separate motor for moving table, saddle and knee. Compare this and the other outstanding features of the new Greaves Mill. You'll see why Greaves is "The MOST Mill for the LEAST Money."

- Wide range of speed/feed combinations for any type material, any type job.
- Heavy, internally ribbed column casting and heavy duty rectangular overarm for maximum rigidity.
- Large, heavy-duty knee, saddle and table provide accuracy for all types of milling.
- New 7½ HP spindle drive motor, with separate motor for movable components, provides extra power for heavy milling.
- Easy-to-reach controls. Handwheels and vertical crank disengage automatically when not in use.
- New rapid traverse lever within operating control area.
- Separate drive motor for table, saddle and knee provides more smooth balanced power at the cutter.

GREAVES
MACHINE TOOL DIVISION

J. A. FAY & EGAN COMPANY
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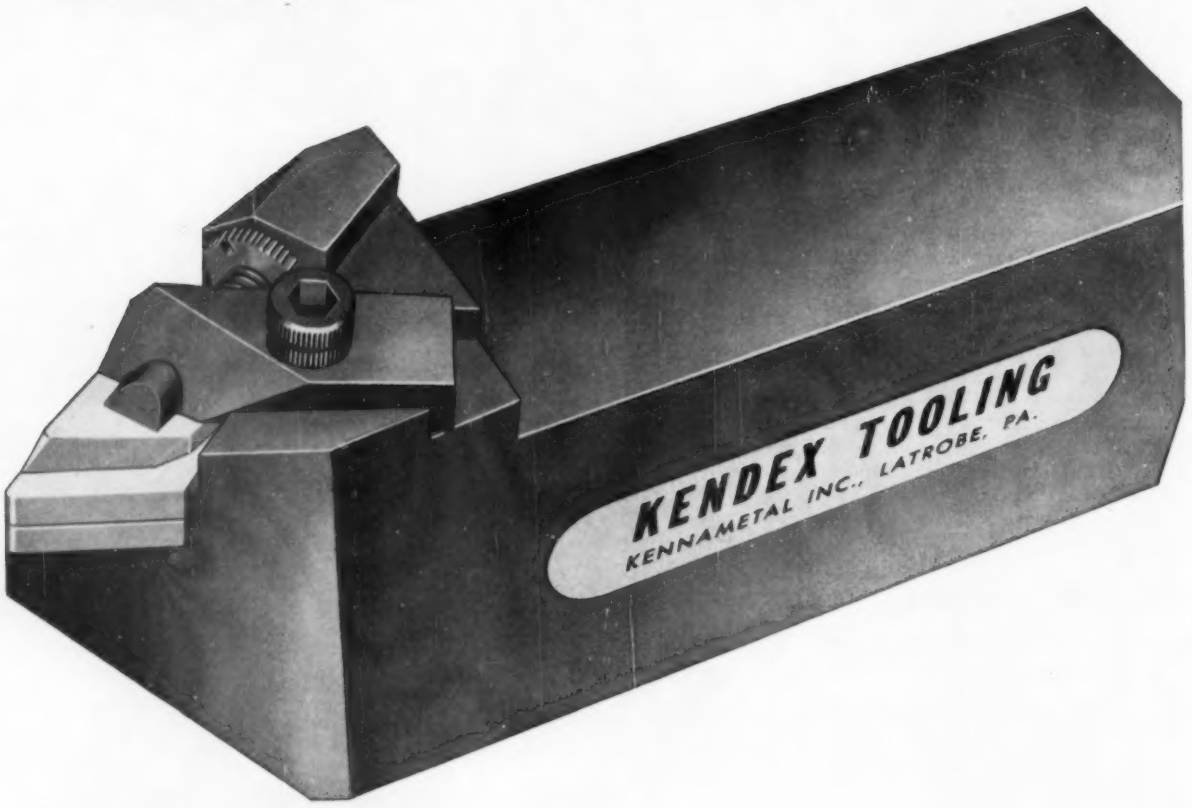
NEW KENDEX* Profiling Tool



The only one with...
a positively locked insert AND an adjustable chipbreaker

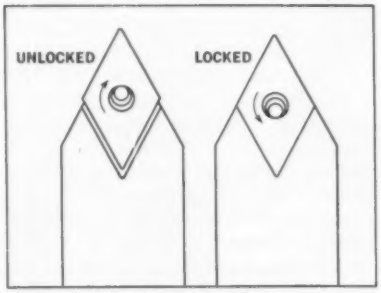
Now in one profiling tool you can get *both* of the latest design improvements. Another "first" from Kennametal Inc., the new Kendex Profiling Tool (A) securely holds inserts during normal cutting, back facing or contouring, and (B) permits a wide range of chipbreaker adjustment by simply turning a dial wheel.

The main design feature of this dramatically new Kendex tool is the eccentric pin that holds the insert securely in place. Positioned through a hole in the insert, this pin, plus the top clamp, positively eliminates any movement of the insert.

Just by turning the threaded dial wheel, the "Dial-A-Breaker" provides a wide range of adjustment of chipbreaker land width. Still another feature is the spring plunger that raises the chipbreaker when the clamp is released, making it easier to change, index or invert the insert.

Performance-proved on job after job over a period of months, the new Kendex Profiling Tool is now available from stock in three holder styles. The diamond shaped insert has a 55° nose angle, suitable for practically any profiling job. It is set in the holder at 5° negative side and back rake to provide four accurately indexable cutting points.

Get the complete story on this new profiling tool. Call your Kennametal Representative or write KENNAMETAL INC., Latrobe, Pennsylvania.



As the wrench is turned it first rotates the eccentric pin, forcing the insert back and locking it against two walls of the recess. Further rotation of the wrench locks the eccentric pin so that it cannot loosen during use.

*Trademark

33578

INDUSTRY AND KENNAMETAL
...Partners in Progress

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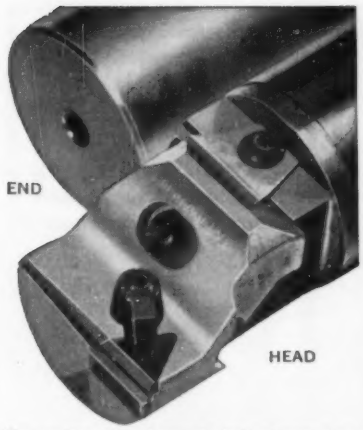

Two or three heads can be interchanged on different style K-Bars for all types of chucking machines, semi-automatic lathes and other precision boring applications.

At Gardner-Denver Company...

This adjustable-head KENNAMETAL* K-Bar replaced 5 "special" bars

Three bores on an 8620 cast steel chuck end previously required five special bars. Chatter and inability to hold size was a problem. Then the Kennametal Carbide Engineer suggested one Kennametal K-Bar be tried for all three bores.

Although the test setup was not ideal (11-inch bar overhang), the K-Bar conclusively outperformed the five bars. Increased machining speeds possible with the K-Bar produced the outstanding time reduction shown.

Material: 8620 steel casting

3-bore operation:
4.470 bore—.325 depth of cut
3.720 bore—.290 depth of cut
3.220 bore—.290 depth of cut

Actual machining time:

Original setup (5 special bars)	16.7 min.
Kennametal K-Bar	3.1 min.
TIME SAVED PER PIECE	13.6 min.

Depths of cuts were varied from .001 to .500 but chatter could not be detected. Ask your Kennametal Representative or write us direct about adjustable K-Bars with Standard Kendex inserts and chip breakers. Seven sizes, 1-inch to 2½-inch diameters. KENNAMETAL INC., Latrobe, Pa.

The high rigidity (3 times that of steel) of Kennametal K-Bars practically eliminates chatter, taper, weaving, and drag-out scoring. K-Bars PERMIT use of harder grades of carbide inserts, faster machining.

*Trademark 97272

KENNAMETAL Inc.

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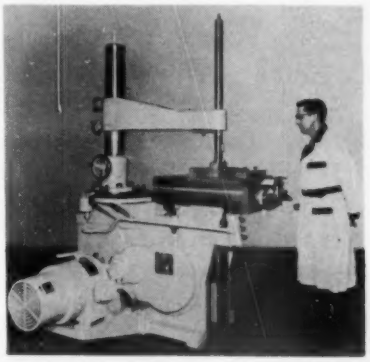
TOOLS of today

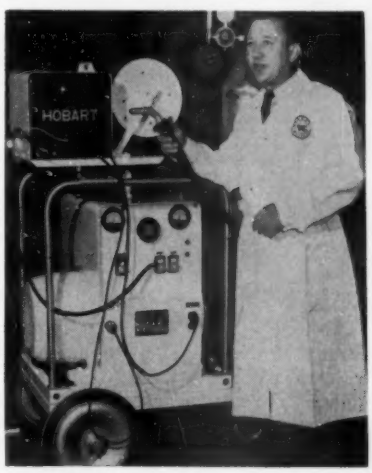
keyseater produces keyways with interchangeable form tools that are wedge-locked in the reciprocating cutter bar. The stroke of the bar, which is guided by a bushing in an outboard support, can be adjusted to a maximum of 24 inches by setting reversing stops on a rotating plate turned by a 3-hp, 790-rpm motor. The table can be tilted to machine tapered keyways and the column for the overarm support has an alternate location to permit cutting keyways opposite spokes in wheels or gears. Seven sizes of cutter bars having diameters ranging from ½ to 2 7/16 inches are provided for the keyseater. Cutters from ⅛ to 3 inches wide are available to fit the various bar diameters.



Star Cutter Co., 34500 Grand River Ave., Farmington, Mich. **Circle 424**

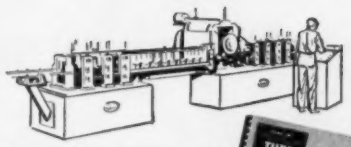
Portable Package Welding Process

Micro-Wire welding is a semiautomatic or fully automatic low amperage electric arc process which continuously feeds a small diameter bare wire elec-



If you need lots of pipe or tube

...YODER makes the mills that make it!



For complete information on YODER Pipe or Tube Mills . . . write for the fully illustrated, 88 page YODER Tube Mill Book . . . it is yours for the asking.

THE YODER COMPANY
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ENGINEERING YODER MANUFACTURING PIPE AND TUBE MILLS (ferrous or non-ferrous)

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IN A HURRY...

to get quality threads at lowest possible cost per salable piece ?

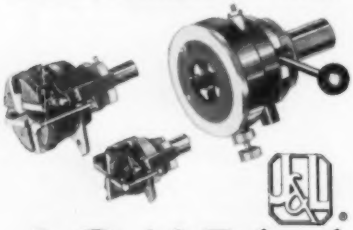
Try J & L Die Heads!

The exacting standards applied to every J & L die head assure you of low cost, high quality thread production.

Every part is hardened, ground and machined from premium, solid alloy steel. And J & L Chasers* are ground in sets to assure exact spacing from tooth to tooth and chaser to chaser.

Write for Catalog GL 5701R for details on the complete line of J & L die heads, chasers, taps, chucks and collets.

*Jones & Lamson Thread Chasers are *guaranteed* to produce threads to Class III tolerances or better.



JONES & LAMSON
MACHINE COMPANY
518 Clinton Street, Springfield, Vermont

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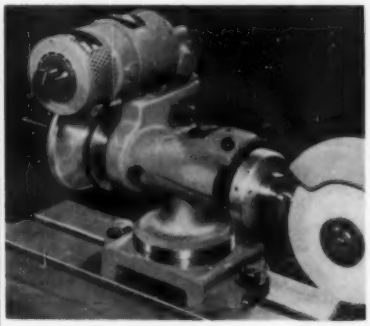
TOOLS of today

trode into a welding zone shielded by a gas. Model 1259 portable package unit includes a 200-amp constant voltage welder with ammeter and voltmeter, wire feed unit, microgun and cable assembly, gas regulator and flowmeter with hose and argon adapter fitting. All components are on a portable mounting with space for carrying two cylinders of gas.

Hobart Bros. Co., Troy, Ohio. **Circle 425**

Grinding Fixture

This grinding fixture can be used for cam-relief grinding and drill point sharpening. The same cam is used for right and left-hand operation. It is infinitely adjustable and the number of flutes that can be ground is virtually

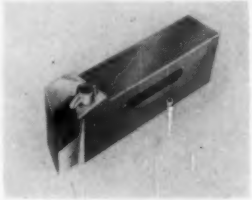


unlimited. The range, when the fixture is used as a drill point grinder, covers 128 sizes from #80 through 1-1/32 inches.

Harig-Steptool Co., 5757 W. Howard St., Chicago 48, Ill. **Circle 426**

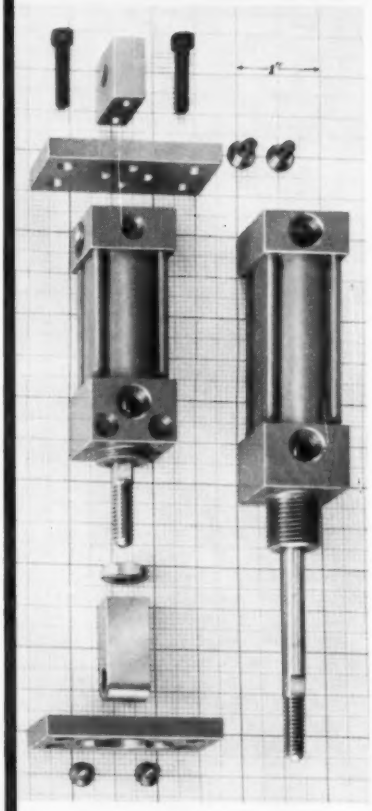
Tracer Lathe Toolholder

Two major problems encountered when 1½-inch long solid carbide diamond-shaped slugs are replaced with indexable tracer lathe toolholders — inadequate clamping and inadequate



seating of the insert — are eliminated with the Wil-Dex tracer lathe toolholder. The cutting insert is fastened by a cam lock that clamps the carbide insert in the insert pocket and locks

HOW SMALL do you want 'em?



Hannifin offers new "Midget-Air" 200 psi cylinders in ¾", 1" and 1⅛" bores, double-acting or spring-return. Two basic models, "universal" and "nose-mounting." Universal models come drilled and tapped for mounting, or for use with any combination of the mounting attachments pictured. Delivery is off-shelf in standard strokes, shipment in ten days to specified stroke lengths. Want dimensions and prices? Write:

PARKER HANNIFIN CORPORATION
PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS
HANNIFIN COMPANY
A DIVISION
519 South Wolf Road
Des Plaines, Illinois
3299-PH

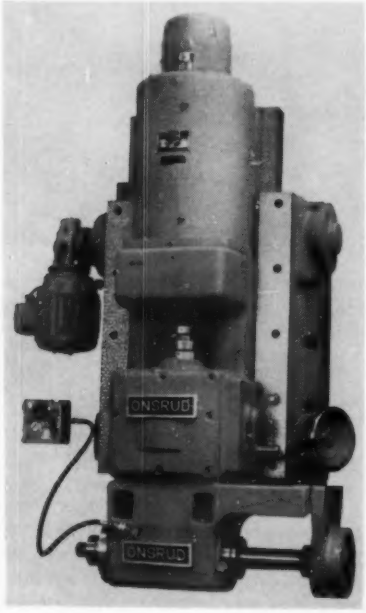
Use Reader Service Card, CIRCLE 77

it against the pocket walls, making insert movement during operations impossible. The indexable diamond-shaped insert also conducts the heat away from the cutting edge, which results in longer tool life. The inserts are indexable four times. Eleven standard sizes designed for use with most tracer lathes are available.

Willey's Carbide Tool Co., 1340 W. Vernor, Detroit 1, Mich. **Circle 427**

Multiple Speed Milling Heads

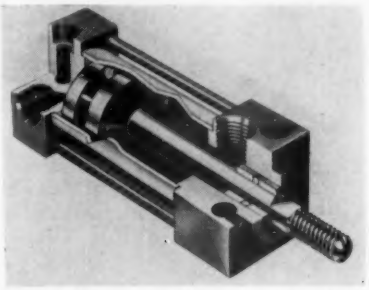
Designed with a gear train drive, the MH-50 series spindle heads give a wide selection of speeds for milling ferrous and nonferrous materials. They are offered in two types, each with 20 to 24 spindle speeds. The first type has speeds from 12½ to 1250 rpm and the second, from 18 to 1783 rpm. Over-all dimensions with the vertical spindle are 20 x 20 x 54 inches. The heads have a liquid-cooled, constant speed, 50-hp, electric drive motor. Vertical positioning is obtained through power drive, with an inching feed for close approach and manual micrometer adjustment. A locking system holds the final adjustment under all operating conditions. The heads are designed for either machine modernization or new machine installations.



Onsrud Machine Works, Inc., Niles 48, Ill. **Circle 428**

Midget Air Cylinder

Offered in ¾, 1 and 1⅛-inch bore sizes with standard strokes ranging to 12 inches in both double-acting and spring-return models, the square head



series "S" Midget-Air — a 200 psi air cylinder — is suited to applications which demand compact size and mounting versatility. The one-piece piston and stainless steel piston rod are brazed together to prevent loosening during operation and O-ring seals assure dependable service at all working pressures.

Hannifin Co., 501 S. Wolf Rd., Des Plaines, Ill. **Circle 429**

Rotary Whiteprinter

The rotary diazo whiteprinter is available in three sizes for making white prints of anything that is written, printed, typed or drawn on translucent material to a width of 42 inches. It has a violet-ray tube and a clear, translucent and unbreakable developing tube. Its controls — emergency reverse, variable speed and starter — are easily accessible. Among its other features are spring steel hangers which provide ball-bearing suspension and act as shock absorbers for the violet-ray tubes; positive-action sprocket-chain drive which assures sharp-controlled reproduction; and a full enclosed ½-hp

Eclipse
INSERTED BLADE
CUTTING
TOOLS
DESIGNED FOR YOUR TOUGHEST
PRECISION CUTTING JOBS
1059
MAJOR DIAMETER
7/8
MATERIAL: Grey cast iron.
JOB: Bores three diameters; faces two surfaces; cuts one chamfer.
TOOL: Eclipse multi-operation carbide tipped inserted blade cutter equipped with a replaceable bronze wear stripped pilot.
RESULT: Finer finish, accurate size and absolute concentricity.
WRITE FOR CATALOG C-59
ECLIPSE COUNTERBORE COMPANY
1600 BONNER AVE. DETROIT 20, MICHIGAN

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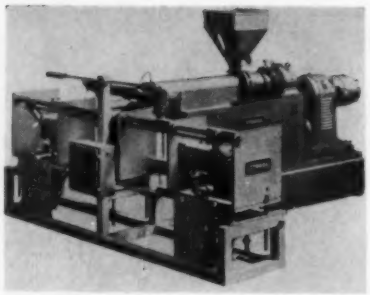
motor with 15 in-lb torque. The pyrex exposure tube can be changed quickly from either end by removing the end plate. The machine operates on ordinary 110 volt 60 cycles a-c current.

Electr-O-Line Corp., 7419 Grand River Ave., Detroit 4, Mich., **Circle 430**

Dual Manifold Blow Molder

This dual manifold blow molding machine is capable of molding plastic products as large as a 5-gal container. Designed to make efficient use of its 3½-inch extruder, Model 856 provides

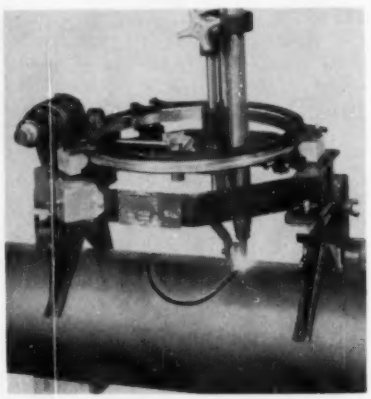


five tons of clamping pressure at each of two molding positions. A two-way valve operated by an air cylinder is located at the midpoint of the manifold to direct the material coming from the extruder to one end or the other alternately. At each end of the manifold an orifice opens downward, through which the material is extruded in the form of a hollow tube, or parison. The two halves of the split mold clamp together to enclose a part of the parison which is then inflated against the chilled surfaces of the mold cavity by an injection of compressed air. The entire clamping and molding section of the machine can be raised or lowered on the base and moved front-to-back by means of screw-jacks on threaded support rods so that the location of the die can be adjusted to the openings in the manifold.

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa. **Circle 431**

Torch Cutter for Holes

Three sizes of the Model ST hole cutter permit cutting 90-deg perpendicular holes up to 18 inches in diam in pipe, tanks and flat plate without cams, patterns or layouts. The oxygen, acetylene torch cutting results in clean,

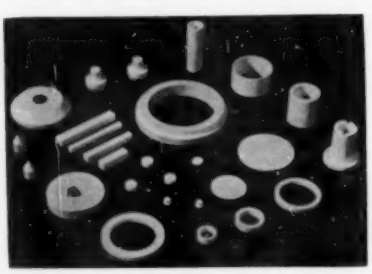


burr-free and weldable edges. The machine is powered by a variable speed electric motor but can be completely hand-operated.

Steffan Mfg. Corp., 1585 S. Lincoln Ave., Salem, Ohio. **Circle 432**

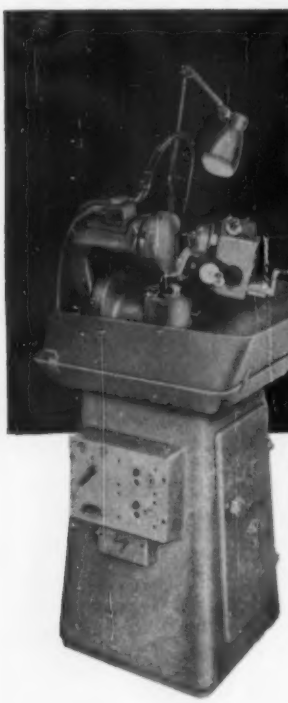
Alumina Ceramics

Heat resistance to 3000 deg F, compressive strengths to 400,000 psi and dielectric strength to 250 volts per mil are properties of the HT-1 series aluminum oxide ceramics. Applications



develop your angles and repeat them!

ALINA SELECT -O- POINT drill grinders



Designed for rapid and accurate grinding of: • Twist Drills • Sub Land Drills • Step Drills • Spot Facing Cutters • Keyway Milling Cutters • End Mills • Reamers • Screw Taps • Engraving Needles, etc.

Three models to choose from — No. 01-2 Range .004" thru .080" — No. 03-6 Range .012" thru .250" — No. 2-32 Range .080" thru 1.250". Each machine is a complete system built around a *planned drill point.* Increases drill life up to 200% by reducing drill thrust force — drills rounder holes to .001" tolerance without bushings or center punching — eliminates reaming operations—special sheet metal point, ground on model *No.2-32* produces round and almost burr-free hole. Accuracy and simplicity is built into each machine.

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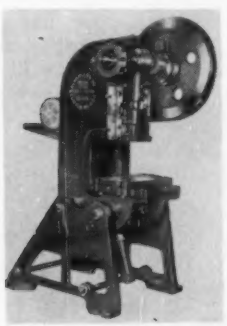
include high-temperature welding locators, RF heating jigs, gages, wire guides, wire drawing dies, brazing fixture components, high-temperature furnace parts, nonmagnetic wear parts, chemical pump parts, semiconductor tooling, electronic insulators, welding shields, abrasive nozzles and valve seats. Ceramic parts are available in diameters to 10 inches. Standard size tolerances are as close as ±0.005 inch as fired and the parts can be ground to 0.0001-inch accuracy.

Duramic Products, Inc., 426 Commercial Ave., Palisades Park, N. J. **Circle 433**

Inclinable Punch Press

Model BT-25—a punch press with a die space shut height of 7⅜ inches and a 8-inch throat—can be setup for any standard punch press operation. It is equipped with a single pin, knife type clutch and can be easily changed from continuous to single-stroke action. Other features are 14-inch long adjustable V-type ram gibs and a tilting mechanism which allows the

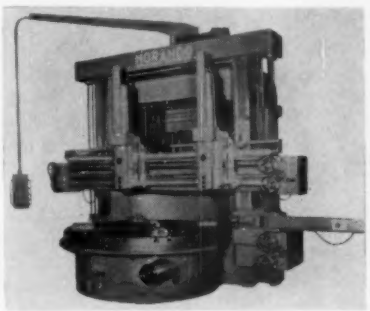


press to incline to 30 deg. The crankshaft diameter at the main 5-inch bronze bearings is 2½ inches. The die bed measures 12 x 21 inches and has an opening of 5 x 8 inches. Power is supplied by a 400-lb, 28-inch-diam, 4-inch face, flywheel. Standard stroke is 2½ inches, with other strokes of ¼ to 4 inches available in ¼-inch graduations. The machine requires a 2-hp motor.

Alva Allen Industries, 1001-15 N. 3rd St., Clinton, Mo. **Circle 434**

Vertical Boring and Turning Machine

One feature of the Morando VK vertical boring and turning machine is its integrated spindle construction which makes a single unit out of the driving gearwheel, flange and crown. The machine has tapered roller bearings located at both ends of the spindle and is available with three speed ranges, each range having 16 speeds. The gear change unit, housed in the lower end of the machine column, is controlled by hydraulic friction clutch and brakes. A wide range of tables—three jaw dual control, four jaws with embedded and inserted independent jaws, flat surface



chuck with parallel T-slots for clamps and additional radial slots—provides clamping versatility. The machine can handle vertical, side and turret heads in any combination. It has a maximum turning height of 90 inches, speeds from 1/5 to 45 rpm and a maximum swing with side heads of 124 inches.

S & S Machinery Co., 140 53rd St., Brooklyn 32, N. Y. **Circle 435**

Barrel Finishing Units

Five different models of the Type LS machine for finishing metal parts are available with either single or double compartments. Barrel sizes are from 21 inches in diam and 20 inches in length to 30 inches in diam and 38 inches in length. The unit has a welded channel

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CEDAR RAPIDS — McNeil Tool & Supply Corp.
CHICAGO — Donald Robertson & Co.
CLEVELAND — Production Tool Co.
DAYTON — J. R. Kontz Company
DETROIT — J. L. Bradford Associates
HACKENSACK — The Eaton Company
INDIANAPOLIS — Donald McIntire
MEMPHIS — Branch-Marwin Tool Specialists
MILWAUKEE — Ford Tool Company
MONTREAL — Humphrey O. Welton
NEW HYDE PARK — The Eaton Company
NEW YORK CITY — J. V. Cremonin (Export)
PHILADELPHIA — General Tool Sales Co.
PHOENIX — Ellsworth Tool Center
PITTSBURGH — Ralph Esposito & Co.
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CIRCULAR TOOL CO., INC.
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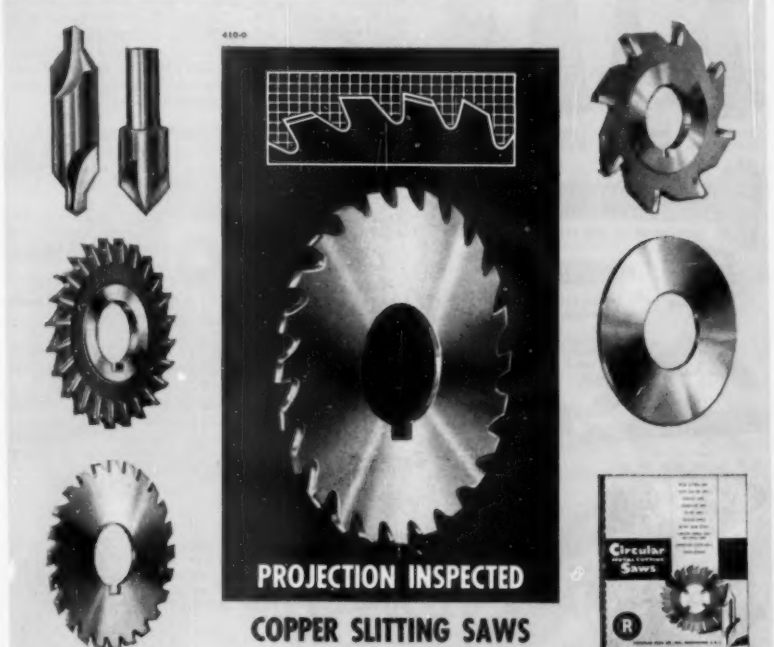

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iron framework, hard maple barrel liners, a guarded chain drive, a variable speed motor, an unloading tray and screens and a removable door with quick-opening latches. Identical to the units designed for finishing metal parts are those for definning plastic parts except that the barrels of the definners are fabricated of 1/16-inch reinforced wire mesh. Both the finishing and definning units can be fitted with a variety of drives. Horsepower ratings range from 1/2 to 1.

Tumb-L-Matic, Inc., Stamford, Conn. **Circle 436**

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Welding Unit

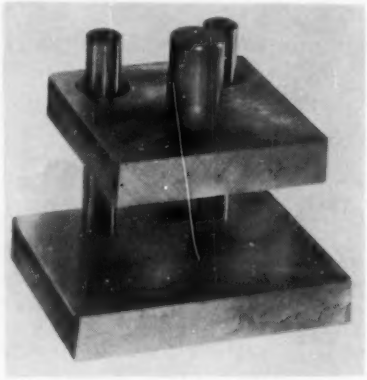
This unit is capable of welding as many as 300 spots per minute, overlapping for hermetic sealing. Its head can be adjusted to spot a ring of welds in a 3-inch radius. Designed for welding metals as thin as one mil, the unit

has a maximum welding pressure of 60 lb. The unit automatically shuts off if the path of the electrode is obstructed.

Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. **Circle 437**

Compact Die Sets

These die sets are available in three lengths—5, 6 and 7 inches—and two shank sizes. The entire line consists of nine sizes with over-all dimensions from 6 x 4 inches to 15 x 12 inches.



The sets are shipped "knocked down" to enable the user to spot the die sections or to drill or machine the die holder before the pins are installed.

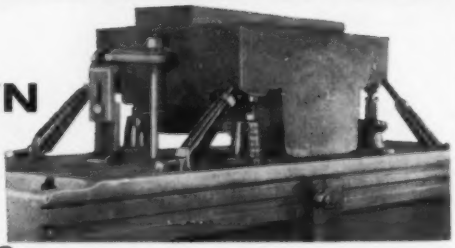
Wheatley Economy Die Sets, Inc., 1627 W. Fort St., Detroit 16, Mich. **Circle 438**

Small Parts Welder

Small components and delicate parts of thin gage material can be welded with the Model 369B bench welder. Included with the machine as standard equipment are a table mounted diaphragm head, a-c electrical and pneumatic controls and a welding transformer. The electrode force is ob-

ARMSTRONG

SET-UP *and* HOLD-DOWN TOOLS



Whatever its shape, a work piece can be quickly, easily and safely set up on any T-slotted table with ARMSTRONG Set-up Tools. Comprising a complete "system" of supporting and holding devices in all essential sizes, ARMSTRONG Set-up Tools usually pay for themselves on the first job and continue to lower costs for years to come.

Save Time: Keep costly machines and high priced men producing—save time otherwise lost while operators rummage in the scrap box for materials with which to devise makeshift set-up methods.

Prevent Breakage and Spoilage—correctly designed, machined from special steels or drop forged and heat treated, they are extremely stiff, strong and reliable.

Increase Accuracy—hold work rigidly and support it fully regardless of shape.

Prevent Accidents—end risk of set-up failure with resulting tool breakage, damage or personal injury.

Increase Profits—by reducing down time, increasing man hour output, assuring accuracy, ARMSTRONG Set-up and Hold-down Tools cut costs and build profits. They are part of every properly equipped tool room and shop.

Your Local Armstrong Industrial Distributor carries a good stock of Set-up and Hold-down Tools. He offers you quick, efficient service on these, as well as other, quality ARMSTRONG Tools.

ARMSTRONG BROS. TOOL CO.
5257 W. ARMSTRONG AVE. • CHICAGO 46, ILL.

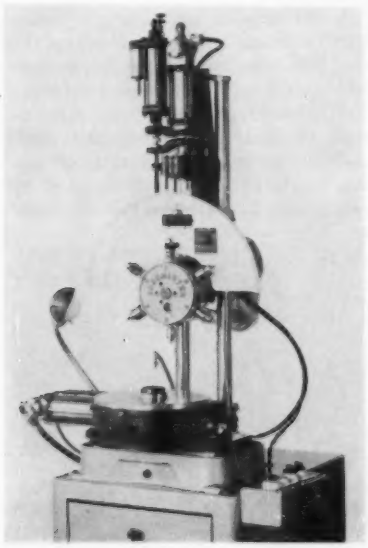
Use Reader Service Card, CIRCLE 81

tained by means of the diaphragm within the 1-1/16-inch ID cylinder. One or more assemblies can be built on the machine base for making more than one weld per assembly with different electrode setups and weld settings. In addition, the design of the weld platens permits inserting electrode holders at right angles to the horn. The welding head has a 1-3/16-inch stroke and a 3-inch throat depth. The electrode force adjusts from 2 to 38 lb and the electrode size can be varied from ⅛ to ¼ inch. The unit is easily changed from spot to projection welding.

Sciaky Bros., Inc., 4915 W. 67th St., Chicago 38, Ill. **Circle 439**

Six-Spindle Turret Drill

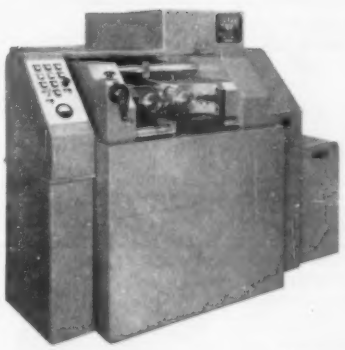
This six-spindle bench model turret drill provides automatic power feed and turret indexing. Its controlled infinitely variable power feeding has preselected individual spindle speeds which automatically shift. Individual depth



For Precision Threading and Forming with Single and Multi-revolution Dies

NEW— Thread Rolling Machine

The Reed B150 Cylindrical Die Thread Rolling Machine is a rugged general purpose two die machine. Its wide range of capacity and versatility meets the demand for both the small lot as well as mass production.



The Standard B150 Machine is arranged for multi-revolution dies with servo cam controlled in-feed operation. Work diameter capacity is from 3/16" to 5".

The B150 Machine may be arranged for high speed production by the addition of automatic work handling equipment and single revolution dies. Work diameter capacity is 3/16" to 1".

Write for Machine Bulletin B-150-1

REED RTD B-150-1

REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

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stops are provided for each spindle to permit rapid traverse to the work and limit the depth of cut. Three modes of operation — manual, semiautomatic, and fully automatic — give the machine added versatility.

Burgmaster Corp., 15001 S. Figueroa St., Gardena, Calif. **Circle 440**

Bore Gage with Interchangeable Heads

Instead of dial indicators, this bore gage uses interchangeable gaging heads, reading directly in 0.00002, 0.00005 or 0.0005 inch. These heads may be interchanged within a range from 0.059 to 32 inches in diameter. They use a lever principle for their amplifying mechanism instead of a gear principle. Measuring pressure is transmitted by means of a ball rolling over a plane sapphire surface. The measuring accuracy is maintained within a fraction of one graduation of 0.00005 inch for the lifetime of the instrument. Extensions for deep bores up to 80 inches additional depth are available and, for measuring bores at hard-to-get-at places, either right angle attachments or right angle bore gages can be furnished. A comparator stand can be used to increase the speed at which mass-produced small parts can be checked.

Mahr Gage Co., Inc., 274 Lafayette St., New York, N. Y. **Circle 441**

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Milling Spindle and Slide Assembly

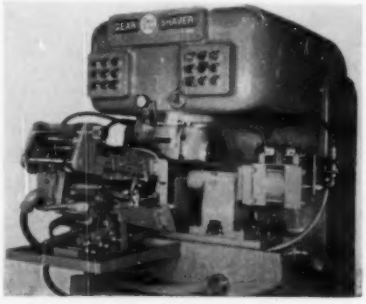
Designed on "building block" principles, the illustrated 20-hp motorized milling spindle and slide assembly has seven speed changes from 70 to 750 rpm. The spindle performs the major cutting operation on a machine for milling the curvature in mill rolls while

the rolls remain mounted in their housings. The rolls are driven in pairs and the machining operation is done in one rotation of the roll. Depths of cut vary from a light finish cut to 0.125 inch. The dovetailed slide—equipped with a micrometer dial, gage bars and vernier scales for setting the cutter position—has a 14-inch movement and motor driven power traverse with disengaging clutch for final manual setting.

Standard Electrical Tool Co., 2499 River Rd., Cincinnati 4, Ohio. **Circle 442**

Unsymmetrical Parts Loader

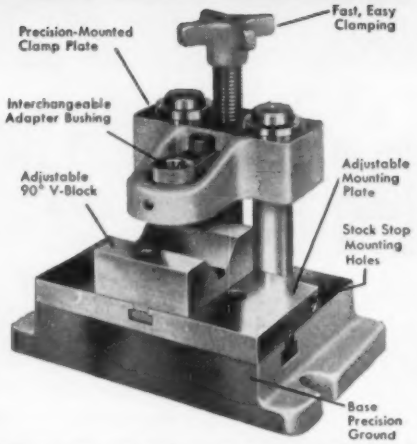
Unsymmetrical parts such as transmission clutch gears can be gaged for size before entry into the input chute with the Red Ring automatic loader. This slide type loader can also be used to feed and unload parts from rotary gear shaving or gear tooth honing machines. The gear on the end of the part is passed between two mas-



REPCO Time-Saving Tools

ADJUSTABLE V-BLOCK
DRILL JIG
Saves Set-Up Time—
Increases Output

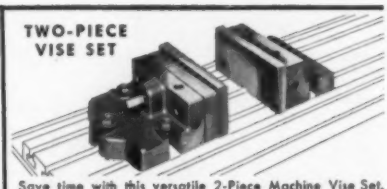
Here is a versatile and accurate V-Block that makes center and off-center drilling, tapping, and reaming easy and precise. Four-way V-block adjustment simplifies handling a wide range of work. Fast, easy positioning and clamping speed production. A centering locator plug and T-slots in the mounting surface plates assure fast, easy, on-center adjustment. Drill capacity #80 to 7/8" diameter. Handles stock from 1/4" to 2" diameter.



TRUE-CENTER ADJUSTABLE TOOL HOLDER

The REPCO Adjustable Holder is a precision-built tool, having two-piece construction which provides fast adjustment of the main body to compensate for as much as 1/32" machine misalignment. Cuts down on tool wear, breakage, and scrap.

TWO-PIECE VISE SET

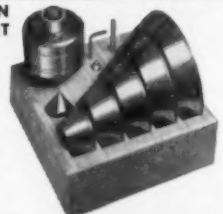


Save time with this versatile 2-Piece Machine Vise Set. Use as general-purpose vise, angle-block, or separate clamping device. Opening limited only to length of machine base. Light, accurate, rigid. Two sizes: 6" and 8".

CHUCK JAW TRUING-RING SET

This Ring Set saves time, cuts cost of boring jaws. With correct diameter rings at hand, you gain hours of productive time. Plated rings range from 1" to 4" by 1/4" increments. Handy peg-type rack keeps rings in place.

COMBINATION LIVE-CENTER SET



Heavy-duty live center plus six interchangeable adapters, ranging from a point to 6 1/4" dia. ball. Saves costly set-up and machining time necessary to make large-diameter centers. Straight and various taper shanks available.

Write for complete information—Exclusive agent territories open.

REPCO ROCKFORD ENGINEERED PRODUCTS CO.
2334 23rd Ave., Rockford, Illinois
Use Reader Service Card, CIRCLE 83

ter gears where the shaft portion of the gear rests on the radial fingers of the lower master gear. The loader—operated by an air cylinder that actuates a slide—feeds the part into the machining position, clamps it between centers, processes it in a controlled machining cycle, unclamps the part and carries it into an exit chute.

National Broach & Machine Co., 5600 St. Jean, Detroit 13, Mich. **Circle 443**

Tubular Riveter

Applications of the Model SMR Electrorivet include work on radio chassis, small speakers, photographic equipment, instruments, toys and switches. An electric bench type, hopper fed riveter, the machine has automatic feeding of as many as 60 parts per minute,

a maximum impact of 3500 lb, a 4-inch throat, a 1⅛-inch stroke and a 7-inch shut height. It uses a 115-volt outlet and completes 144,000 work cycles on 1.3 kwhr of electricity. Its operation is all-electric.

Black & Webster, Inc., Watertown, Mass. **Circle 444**

Bench Model Vibrator

Designed for finishing small and delicate parts, the Model 610 vibrator is equipped with a 6 x 10 x 8-inch bowl which, with its ¼-cu ft capacity, can hold 35 lbs of parts or media. A ¾-hp motor drives a variable shaft with a variable pitch pulley. Speeds range from 700 to 3500 vpm and the amplitude is varied by changing the position of counterweights on the shaft.

Lord Chemical Corp., 2068 S. Queen St., York, Pa. **Circle 445**

Horizontal Broaching Machine

Although it is designed for external or internal broaching on a high production basis, the universal horizontal broaching machine is also practical for short run jobs. Hydraulic power is supplied to the machine by a unit

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consisting of a pump; a 220/440, 3-hp, 60-cycle motor; a pressure valve; a solenoid-operated 4-way valve; a speed control valve; and a hydraulic fluid reservoir. The machine is available in capacities of 1, 2 or 3 tons, stroke lengths to 72 inches and ram speeds from 40 to 100 fpm.

Ty Miles, Inc., Box 446, Elmhurst, Ill. **Circle 446**

Diamond Grinding Pins

Available in cylindrical shapes in 25 diameter sizes from 0.2 to 0.5 inch, these diamond grinding pins can be used for many operations on steel, ceramics and carbides. In the smaller size range, the pins are graduated in size in 0.01-inch intervals, enabling a maximum size shaft to be used to insure greatest accuracy by minimizing the possibility of whip.

Titan Tool Supply Co., 1419 Hertel Ave., Buffalo 16, N. Y. **Circle 447**

New plant of Eastern Tool & Stamping Co.

Dickerman 9" Rol-Di-Feed handles brass stock .064 thick and 8" wide with dependability, hour after hour. Draw of 2" is required on this box shaped piece part.

Rol-Di-Feeds selected by Eastern Tool & Stamping Company for VERSATILITY!

The 9" Rol-Di-Feed feeds up to 9" on each press stroke. The 12" Rol-Di-Feed up to 12" per stroke. These are but two of 15 dependable Dickerman Feeds that are available off-the-shelf for immediate delivery to solve practically all of your press feeding production problems speedily, dependably. And versatility of Dickerman Feeds makes them interchangeable on job after job. They feed deep drawing dies, progressive dies, piercing or blanking dies with equal ease, accuracy and economy.

Dickerman

Send for literature and prices on 15 Dickerman stock feeds today!

H. E. DICKERMAN MFG. CO. 101 Albany Street, Springfield, Mass.

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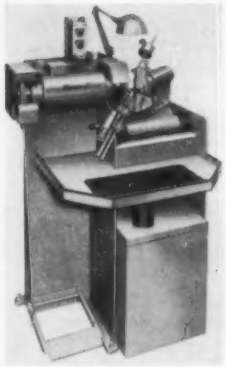
Multipoint Drill Grinder

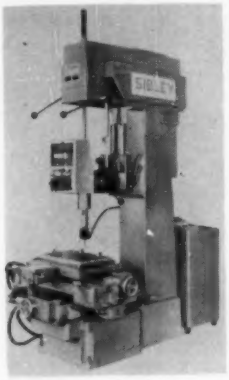
Both general and special points can be produced with the Model DG-1 drill grinder by adjusting the ⅛ to 1-inch drill holder. The holder can be swiveled to any point angle between 60 and 180 deg and set for minimum, maximum or normal relief angles. It has an adjustable stop for limiting its swing for three and four lip drills and its mounting can be moved with a handwheel to make use of the wheel corner for step, subland, split point and modified split point drills. The machine, available for either wet or dry grinding, works on the conical grinding principle.



Hammond Machinery Builders, Inc., 1661 Douglas Ave., Kalamazoo, Mich. **Circle 448**

Program-Controlled Drilling Machine

Among the features of the HT-40 drilling machine are automatic work positioning and program control of the operation. The machine is equipped with a two-axis point-to-point positioning table. Leadscrews control the table movement through 14 x 18 inches of travel and two steel tapes, indented during initial setup, control table location. Containing only simple electric components, the table is accurate to ±0.001 inch. Spindle runout is less than 0.0005 inch. The drilling information center, mounted on the sliding head, contains all electrical controls for both the table and the machine. Written instructions for each machining function in the work cycle are given to the operator through a prompter window.



Sibley Machine & Foundry Corp., 206 E. Tutt St., South Bend 23, Ind. **Circle 449**

Linear Motion Potentiometer

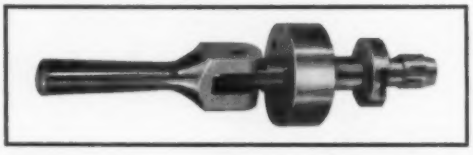
This ½-inch-diam linear motion potentiometer can be used in continuous process instrumentation or direct read-out devices relating to speed, feed thickness and gaging controls; in feedback systems for programming machining operations; and with the fluid flow rate and pressure controls of hydraulic systems. Its resistive element embodies a track of conductive plastic integrally molded to a phenolic base. Character-

LOCATION TOLERANCES OF .0004"

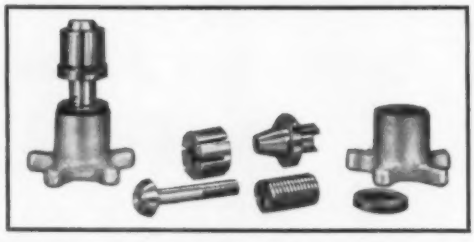
with SPEEDGRIP expanding locators

Gain accuracy—Save time—Avoid errors in loading or unloading work from fixtures! Speedgrip expanding locators are *guaranteed* to repeat fixture location within .0004". Nationally known customers find Speedgrip locators indispensable for holding required tolerances! Assures easier loading and unloading of work.

No. 0 Speedgrip Locator with cam lever actuation. With corresponding bushings, this locator will accommodate bores from 1/2" to 3/4" dia.



No. 2 Locator with hand knob actuation. With expansible bushings, this locator can be used for bores from 1" to 2" dia.



This No. 5 locator can be supplied for either wrench or draw bar actuation. Has precision ground pilot on under side of flange for mounting to fixture. With expansible bushings, this locator can accommodate bores ranging in size from 5" to 11" dia. Locators, with various means of actuation can accommodate bores, ranging from 3/8" to 11".

Some Open Territory • Dealer Inquiries Invited

FREE! Write for Bulletin No. 27 for full description and technical details.

SPEEDGRIP CHUCK
Division of ERNEST, HOLDEMAN & COLLET, INC.
Elkhart, Indiana

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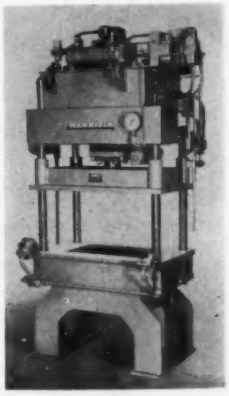
ized by low electrical noise and an ability to resist vibration and shock loading, the potentiometer is designed to withstand as much as 1000 volt rms without dielectric failure. It has electrical output accuracies of ±0.5 percent and element resistance ranging from 1K to 20K ohm.

Markite Corp., 155 Waverly Pl., New York 14, N. Y. **Circle 450**

Trimming Press

Capable of operating speeds to 1300 ipm, this 30-ton, four column hydraulic trimming press has a 240-ipm feed and a 790-ipm return. Its soft shearing action—a squeeze rather than a blow—

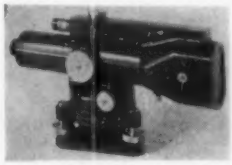


results in clean accurate trims, reduces danger of die damage and minimizes rejects. The machine has a 20-inch stroke and a 30-inch gap. Included with the machine are a 20-hp motor and a 31-gpm pump.

Minnifin Co., Des Plaines, Ill. **Circle 451**

Self-Setting Optical Level

Even when the telescope is tilted, the Autoset optical level automatically maintains a level line of sight. It has a repetitive setting action closer than 1 sec of arc. Oscillation of the prisms



is eliminated by an air-damped piston which also limits swing to ±20 min. The instrument reads directly to 0.001 inch over ½ inch within a focusing range of 6 feet to infinity.

Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill. **Circle 452**

Digital X-Y Plotter

Accuracy of ±0.001 inch on a 48 x 48-inch working surface is possible with this automatic digital X-Y plotter. Since it is operated on a digital measurement basis instead of a percentage basis, warm-up time and possible drift are eliminated. Plotter inputs can be from punched cards or paper tape, keyboard or magnetic tape. Slewing speeds are 0.004, 0.08, 0.8 and 4 ips. The print head has eight individually operated print wheels and a pin to punch the precise location of the plotted point. Each print wheel carries 12 symbols.

Gerber Scientific Instrument Co., 89 Spruce St., Hartford, Conn. **Circle 453**

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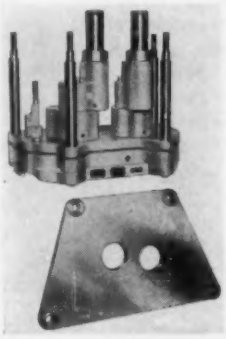
Adjustable Drill Head

Multiple-spindle drilling of large holes in hard-to-machine material can be performed with this double-eccentric adjustable drill head. Illustrated is a two-spindle head with template built to drill 2-inch-diam holes in solid steel



Dies cost less to build, less to buy
when you specify
RING Punches and Dies

Check your in-shop estimates. Then check Ring prices. Figure the extra savings in reduced die assembly time ...and you will see how you can economize with Ring, yet retain quality.

RING or SOLID HEAD type punches in stock...round, oblong, square, rectangular, slug ejector, pilot, blank. *All punch points ground to specified decimal sizes at no extra charge.* Ring or press fit type dies from stock with hole sizes to proper clearance for the material to be punched. SPECIALS in choice of steels, to your specifications.

WRITE Dept. E for New Catalog of headed and Ring punches and dies, ejector punches, shoulder and bevel quills, and stripper guide bushings.

RING PUNCH & DIE DIVISION
OF THE PRODUCTO MACHINE COMPANY
JAMESTOWN, NEW YORK

PRODUCTO

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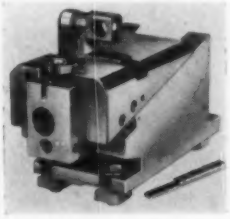
forgings. Each spindle of the Super-H-D head adjusts within a radius of 7.2 inches about the drive and a maximum center-to-center distance of 22.4 inches is possible. The ball bearing construction and heat-treated and hardened steel gears and spindles used in the head are readily adapted to carry exceptional loads. The head contains #5 Morse Taper spindles.

Thriftmaster Products Corp., 1048 N. Plum St., Lancaster, Pa. **Circle 454**

Dual Recess Toolholder

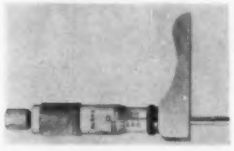
This clamp type recess toolholder can simultaneously cut an internal and external groove on the end of a part. For use with multiple spindle bar and chucking machines, it mounts on the main toolslide and is actuated by a drawbar. The depth of cut, externally and internally, can be independently adjusted. The device is furnished with a single reversible tool setting gage and a tapered gib for take-up adjustment.



Screw Machine Tool Co., 17565 Swift Ave., Detroit, Mich. **Circle 455**

Micrometer Depth Gages

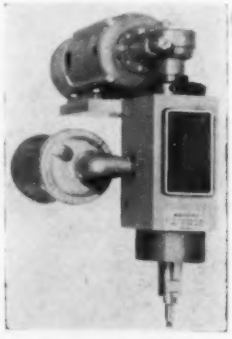
No. 443 series micrometer depth gages are designed with a short half base to facilitate depth gaging close to shoulders or between obstructions where ordinary full base gages will not go. They are available in three size ranges: 0 to 3 inches with three rods; 0 to 6 inches with six rods; and 0 to 9 inches with nine rods. The sleeve and thimble on the gages have a no-glare finish. Graduations are in 0.001 inch.



L. S. Starrett Co., Athol, Mass. **Circle 456**

Riveter Head

This spin-impact, peening type riveter head can be mounted vertically, horizontally or at an angle on a column, pedestal, panel or made part of a special-purpose tool assembly. A small motor rotates the air-operated piston, resulting in a rapid succession of peening blows by the rotating tool.



Hill Machine Co., Rockford, Ill. **Circle 457**

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Blade Control Engineering ☆ at EVERY Critical Point gives you LONG BLADE LIFE!

★ 22" Blade Wheels
★ 15½" Pivot Span
★ Blade Twist Only 30°
★ Rigid Guide Arms
★ Rugged Construction, Eliminating Destructive Vibrations

THIS FREE CIRCULAR WILL GIVE YOU ALL THE COST-CUTTING FACTS!

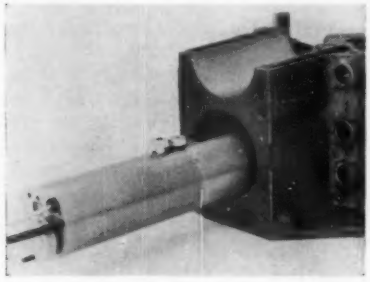
Write for this 6-page circular. See for yourself how the MILBAND Machine is engineered for fast cutting, long blade life and low per-cut costs on heavy-duty sawing with high speed steel band saw blades. At the same time, ask us to arrange a demonstration and let us show you how a MILBAND can save time and money on your toughest jobs.

THE HENRY G. THOMPSON & SON CO.
Chapel & Dill Streets, New Haven 5, Connecticut
Saw Specialists for 85 Years

Use Reader Service Card, CIRCLE 88

Device for Detecting Surface Irregularities

Irregularities on practically any type of surface can be measured and recorded with the Proficorder and its accessory, the internal linear pilotor. This electromechanical instrument is being used on metals, plastics and glass. A 4-inch wide strip chart on which ver-

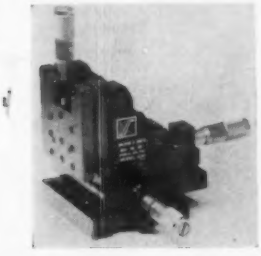


tical readings are magnified many thousands of times and horizontal readings many hundreds of times permits checking of flatness, roundness, waviness, roughness, flaws and total profiles.

Micrometrical Mfg. Co., 3621 S. State Rd., Ann Arbor, Mich. **Circle 458**

Micropositioner

Model 200 micropositioner has three micrometer assemblies which insure a steady measured movement up to ½ inch. Both vertical and horizontal face plates contain holes for mounting tooling or other devices or mounting onto



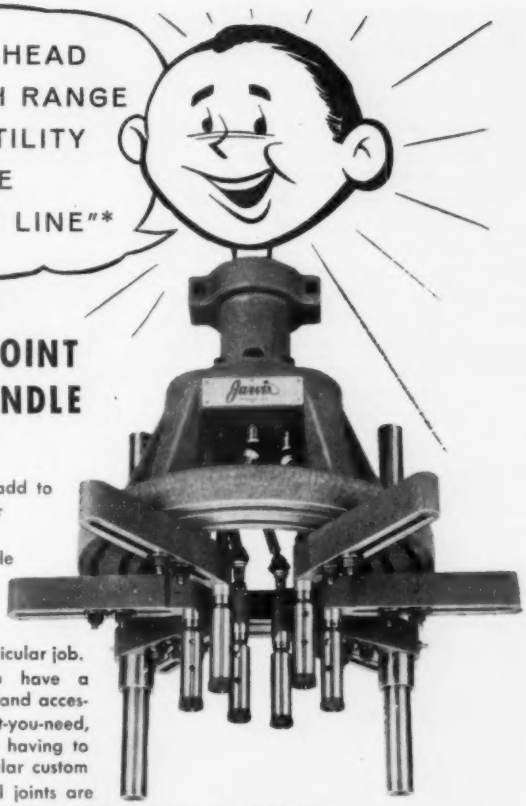
other equipment. The unit provides positioning in three planes—X, Y and Z—and can be used to control the movement of either a part or tool during manufacture. It has a range of 0.5 inch in the horizontal vertical planes.

Kulicke & Soffa Mfg. Co., 1234 Callowhill St., Philadelphia 23, Pa. **Circle 459**

Tempering Furnace

Type OLB series Bell-Temp atmosphere furnace is used for bright tempering stainless steels and for other heat-treating applications. Within its

"NO OTHER HEAD OFFERS SUCH RANGE and VERSATILITY ON THE PRODUCTION LINE"*

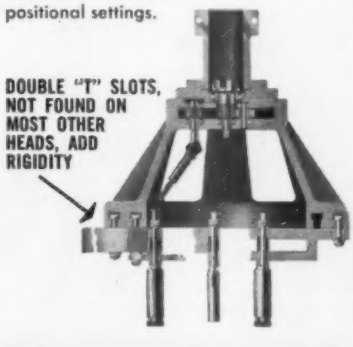


JARVIS UNIVERSAL JOINT MULTIPLE SPINDLE HEADS

* For example, you can add to the basic head one or more of 20 optional accessories (such as Spindle Assemblies, Spindle Cluster Plate, Base Plate, Guide Rods, etc.) to meet the requirements of a particular job. With Jarvis Heads you have a greater selection of parts and accessories. A buy-only-what-you-need, custom-built head without having to pay the high cost of regular custom designed heads. Universal joints are of an advanced structural design which feature: low deflection rate; superior fatigue resistance; greater overload capacity and longer life. Joints have a snap-on feature and can be slipped off the spindle without use of tools.

EXCLUSIVE JARVIS FEATURES

Cut-away view (below) reveals high strength, light weight aluminum alloy castings, heavily ribbed for durability; gears and spindle drivers run in ball bearings, have more than thrust load capacities; idler gears mounted on heavy duty needle bearings running on specially heat treated steel studs; adjustable outrigger arms locked in position with threaded studs located in double "T" slots for positive positional settings.



NO NEED TO INVENTORY SEVERAL FIXED HEADS

Head converts easily to a fixed head by adding a Jarvis Spindle Cluster Plate (shown below) which can be jig bored, by you or by us, to locate spindles to suit hole spacing required. Cluster Plates will aid in reducing setup time and will assure correct setup each time.

Jarvis CORPORATION

SEND TODAY FOR COMPLETE DETAILS

JARVIS CORPORATION,
30 Pease Ave., Middletown, Connecticut
____Send U.J. Multiple Spindle Head Catalog

Name _____ Title _____

Company _____

Street _____

City & State _____

Use Reader Service Card, CIRCLE 89

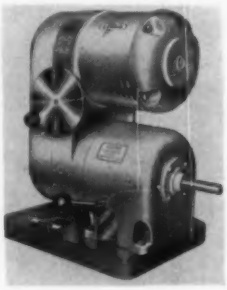
bell type insulating outer shell, which is lifted during the cooling cycle, is a sealed retort enclosing the work load, heating elements, baffles and forced convection fan. Two models are standard, one for workbaskets with a 13-inch diam and 17-inch depth and the other for 24-inch deep, 17-inch diam workbaskets. The temperature range of the furnace is from 250 to 1250 deg F.

C. I. Hayes, Inc., Cranston, R. I. **Circle 460**

USE READER SERVICE CARD ON PAGE 183 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Variable Speed Drive

Speeds possible with the variable drive range from 180 to 1800 rpm when using a 1800-rpm motor or from 120 to 1200 rpm when using a 1200-rpm motor. The unit has a four-speed transmission. A control wheel regulates the output shaft to the desired speed and a pointer indicates on a calibrated plate the rpm speed at which the output shaft is turning.



Lima Electric Motor Co., Inc., Lima, Ohio. **Circle 461**

Rapid-Curing Epoxy Adhesive

Cure time of this formulated resin-hardener adhesive system is 60 sec at room temperature or 45 sec when an infrared lamp is used. It is ideal for meter-mixing-dispensing units in production line work. Since its applications include bonding metal to metal, plastic to metal, plastic to plastic or any other porous or nonporous surfaces, it eliminates many soldering operations.

Allaco Products, 238 Main St., Cambridge 42, Mass. **Circle 462**

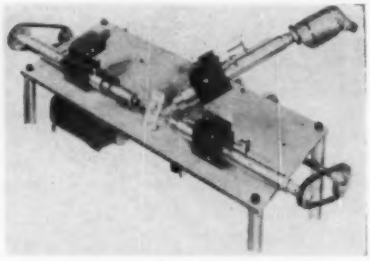
Gage Extensions

Four extensions for the Truarc location gage increase the gage's range for measuring the distance from the outer wall of a beveled or rectangular groove to a plane of reference from 0.4 to 1.4 inches to from 1 to 11 inches. They are 1, 2, 3 and 4 inches in length and may be used individually, in combinations of varying length or with all four attached to the gage spindle. Knurled ends facilitate attaching and removing the extensions from the gage.

Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y. **Circle 463**

Multi-Angle Drill Unit

Type A drill unit has unlimited mounting flexibility to handle angle or off-line drilling jobs. It has a drill capacity of ¼ inch in steel and any length stroke can be setup to its full



4-inch capacity. The unit has a two-way air cylinder which provides both feed and return of the spindle.

Commander Mfg. Co., 4225 W. Kinzie St., Chicago, Ill. **Circle 464**

So it doesn't break---*So what??*

So we can bend a MARVEL High-Speed-Edge Hack Saw Blade double, and it won't break. Does this prove anything?

Let's see if it does. When you buy a box of hack saw blades, you expect each blade to have a reasonable cutting life. For example, take an ordinary blade that costs $4.00, and you expect it to produce 2000 sq. inches of accurate cutting-off before it is discarded. Would you be willing to pay $8.00 for that same blade? *You will, if it breaks halfway through its expected life.*

Bending a MARVEL High-Speed-Edge Hack Saw Blade to demonstrate that it is truly unbreakable proves the point that you get every square inch of blade life you pay for when you buy MARVEL Blades.

Safety to both operator and machine, plus maximum blade life, seem like value enough from this remarkable blade. However, these MARVEL Blades give you even more, for they will cut faster, with greater accuracy because they can be safely tensioned more taut in your machine than ordinary "breakable" blades and are therefore more rigid to resist deflection.

Cost? Unbreakable MARVEL High-Speed-Edge Hack Saw Blades are priced competitively. Use MARVEL Blades consistently with complete confidence because they have no equal for value. Leading Industrial Distributors stock and sell MARVEL. Ask yours today.

ARMSTRONG-BLUM MANUFACTURING CO.
5700 West Bloomingdale Avenue • Chicago 39, Illinois

MARVEL Metal Cutting SAWS

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technical shorts

New Ceramic Metal-Casting Technique

A new ceramic-mold metal casting technique for manufacturing high-strength, close-tolerance tool, die and structural components has been developed by Shaw Process Development Corp. The process provides for fast, economical production of complex shapes of virtually any size. In practice, it has been found that conventional hot-work steels such as D-5, H-11, H-13 and H-21 are ideally suited to the process, although they present difficulties when machined conventionally.

Advantages of the technique stem from a special ceramic material used in production of the mold. This material introduces the phenomenon called "microcrazing"—a network of minute fissures through which air and gases can escape. This eliminates the porosity, inclusions and surface cracks normally found in conventional casting.

Elevated Temperature Protection

A new coating, Cermet N16, has been developed by North American Aviation's Columbus Div. to protect metals used at temperatures ranging from —65 through 2000 F. Providing comparative inexpensive protection, the coating is adaptable to such metals as low-carbon steel, tool steel, cast steel, enameling iron, cast iron, copper, stainless steels, and the exotics.

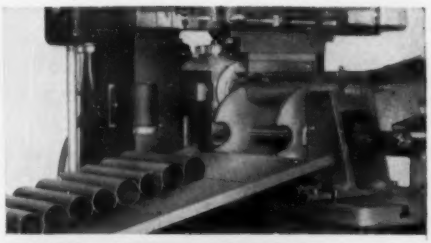
X-Rays Measure Intragranular Irregularities

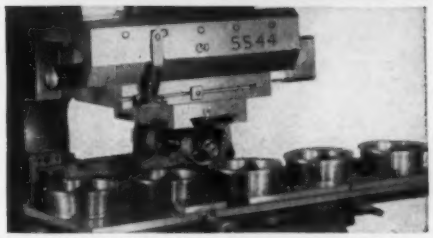
An X-ray diffraction method has been developed at the National Bureau of Standards to measure intragranular misorientation in metals. To date the method has been used to derive numerical values for this structural parameter in cartridge brass specimens. The data obtained indicates that some of the misorientation induced by plastic deformation in tension disappears after compression. Experimental results of this work will be used in Bureau research on metal fatigue and in studying the mechanical properties of metals.

The grains or crystallites of which an ordinary polycrystalline metal specimen is composed may become misoriented when very small amounts of plastic strain are applied. This misorientation has been qualitatively determined in studies of metal structure; however, only a few quantitative measurements have been obtained, and these required techniques of considerable complexity. To devise a simpler technique of quantitative measurement, C. J. Newton and H. C. Vacher of the Bureau's mechanical metallurgy laboratory undertook the present investigation.

Uses Mount for Carbon Dioxide in Liquid Form

New uses for liquid carbon dioxide as a coolant in industry have nearly doubled its production in the past five years, while output of harder-to-handle dry ice has dropped off. Cardox Div. of Chemstron Corp., a company producing both types of carbon dioxide attributes increased consumption of the liquid to the demands of modern automation. In many instances, new devices and more efficient equipment have made it possible to introduce liquid carbon dioxide into processes where dry ice normally would be used. This has resulted in increased ease of handling and cost savings.





ABOVE: Model 175 is a self-contained, *hydraulic powered* marking machine that's ruggedly constructed and *performance proved*. This general purpose machine is designed for heavy duty *numbering, lettering* and *knurling*. Adaptable to a wide range of marking applications with GTS special fixtures.

ABOVE, TOP: Model 175 with chute feed has *Geneva movement in revolving spider*, and retractable geared arbor. Marks over 2000 tubes per hour.

ABOVE, BOTTOM: In line production Model 175, with shuttle feed, marks 300 bearing races per hour. Dual knurls mark radially in two locations.

MODERNIZE YOUR MARKING METHODS...IT PAYS

The *general purpose* Model 175 *can be automated* with GTS special fixtures and tools to modernize for better marking and lower cost marking. Whether used for *all-around* general purpose marking, or as an automated machine, the Model 175 can cut your direct production costs. You can have flexibility, *built-in*, to mark more parts, do more marking on parts . . . with uniform *easy-to-read* impressions.

For sharp impressions and long-run economy, *always specify* GTS Marking Tools.

Longer marking tool life, lowers tool cost.

GTS experience *can solve* your marking problems. Let our Marking Engineers help you determine the *best methods* for you.

WRITE FOR COMPLETE CATALOG OR PHONE EA 7-0300

GEO. T. SCHMIDT, INC.

1802 W. Belle Plaine Chicago 13, Ill

IF IT'S WORTH MAKING, IT'S WORTH MARKING

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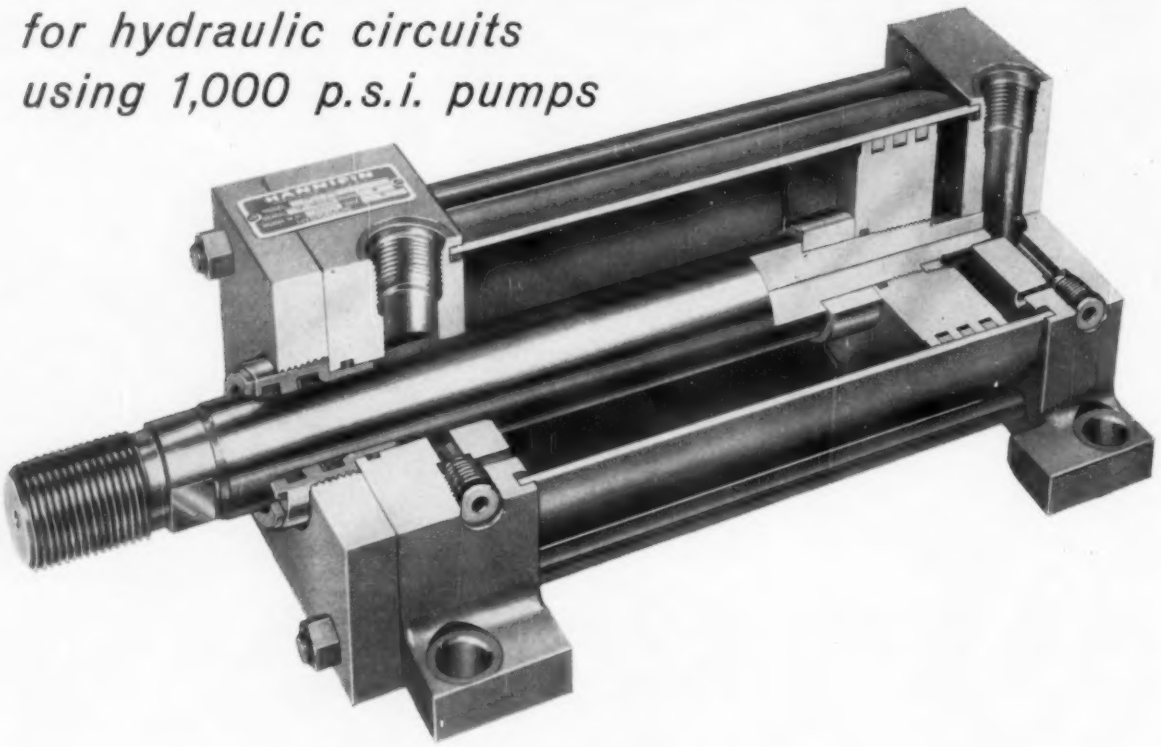
NEW FROM HANNIFIN
THE THOUSAND POUND LINE!

for hydraulic circuits
using 1,000 p.s.i. pumps



- *A true hydraulic cylinder – not a modified air cylinder*
- *Offered in nine bore sizes – 1" through 8"*
- *Every model withstands at least 1,000 p.s.i. in every bore size*
- *Built to save you money – yet not "built to a price"*

Now, for the first time in hydraulic cylinder manufacture, Hannifin offers a top quality cylinder tailored to the medium-high-pressure hydraulic circuits you operate off 1,000 p.s.i. pumps.

Series "L," the "Thousand Pound Line," is NOT a modified heavy duty air cylinder. It is built for the job . . . with steel heads and steel barrel for full compliance with J.I.C. hydraulic recommendations. Other extra-quality features include an induction hardened and hard chrome plated rod, nodular iron piston with cast-iron piston rings — leakproof "Lipseals®," optional — longer cushions on cushioned models, and the Hannifin-developed bronze cartridge gland with both "Lipseal®" and "Wiperseal" to keep the rod drip-free. S.A.E. straight thread "O" ring ports as recommended by J.I.C. are optional at no extra cost just as they are in the Hannifin heavy duty Series "H" hydraulic cylinder.

Parker-Hannifin field engineering service can help you meet your needs precisely, help you select the proper Hannifin cylinder for any service, air or hydraulic. Call your nearest Parker-Hannifin sales office or write direct for our new bulletin giving all dimensions of Hannifin Series "L" cylinders.

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PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

3077-PH

Paul H. Setzler was recently named vice president and general manager of Lord Chemical Corp., York, Pa. H. R. Stitely, former president, is succeeded by James F. Connaughton, president of Lord's parent company, Bell International Corp. Prior to joining Lord, Setzler served in various capacities for Baldwin-Lima-Hamilton Corp., Babcock & Wilcox Co., Lukenweld, Inc., and Lincoln Electric Co.

Men at Work

Penn Machine Co. has appointed W. O. DICK as vice president and general manager of its subsidiary company, Canton Malleable Iron Co., Canton, Ohio. Beginning his career with the New York Central Railroad, Dick has served in various positions with Baldwin-Lima-Hamilton Corp. and Westinghouse Electric Corp.

JACK T. LE BEAU has been elected vice president in charge of the abrasives division of Besly-Welles Corp., Chicago, Ill. Le Beau, who has been with the firm for 24 years, replaces NORMAN C. MINEHART.

WILFRED THOMPSON, in his new position as vice-president in charge of sales for Bullard Co., Bridgeport, Conn., will be responsible for the sales of the company's entire line of products. Since 1950, he has been district sales manager with headquarters in Detroit, Mich.

GEORGE E. BEE was reelected president and G. KENT ROSENQVIST, vice president, of Dytronics, Inc., a subsidiary of Taylor Fibre Co., Norristown, Pa. HARRY D. WISE, JR., and STANLEY S. ANDERS have been named secretary and treasurer, respectively. Bee has served as president of Dytronics since August of 1960 and for the previous nine months had been executive vice president. Rosenqvist has been vice president since the company was founded in 1958.

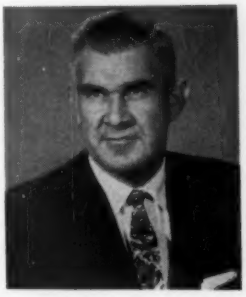
NORMAN A. RAUTIOLA, previously a senior patent examiner in the fields of meallurgy and semiconductor for the U.S. Patent Office, has joined the staff of Bjorksten Research Laboratories, Madison, Wis., as assistant to the executive vice president. KENNETH A. BOUSCHART has also joined the firm as staff electrical engineer in the physics division. He was formerly with AC Spark Plug Co. in its inertial guidance systems laboratory.

W. G. HILL, previously an assistant engineer, has been named chief engineer of Wilkerson Corp., Englewood, Colo. Prior to joining the firm, he was a design engineer for North American Aviation, Columbus, Ohio.

Logansport Machine Co., Inc., of Logansport, Ind., has announced that L. R. BURGER was elected to the office of vice president. In his new position, Burger will be responsible for sales.

PERRY R. ROEHM has been named executive vice president of Barden Corp., Danbury, Conn. He rejoined the firm as vice president last July after having been with the firm from 1944 to 1955 as sales manager and vice president.

JOHN E. ECKERT has been appointed vice president in charge of engineering of Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., and is succeeded in his former position as chief engineer of the rolling mill division by ANDREW J. BECK. Eckert has served in various positions with American Rolling Mill Co. and with Armzen Co., a firm which was merged with Waterbury Farrel Foundry & Machine Co. Beck was also employed by Armzen Co.



In an announcement recently made by W. R. Gerchow, executive vice president and general manager of Buhr Machine Tool Co., Ann Arbor, Mich., Richard Miller was appointed manufacturing manager. Miller's background includes several executive and manufacturing positions in the machine tool and automotive fields.

Cutler-Hammer, Inc., has announced that RAYMOND C. MILES has been named director of the engineering and production division of Airborne Instruments Laboratory, Deer Park, L. I., N. Y. Since joining the firm in 1950, he has served as head of the electrical design section of the engineering department and the industrial products department and as manager of the government products department. He has also been associated with the Federal Telephone and Radio Corp. and Haller, Raymond and Brown, Inc.

GEORGE E. HUDSON and R. M. G. BOUCHER, of New York University, have been named consultants to International Ultrasonics, Inc., Rahway, N. J. The two were also elected to the company's board of directors along with BENJA-

Edward N. Nelson (left) has been named product manager of carbon and coated strip steels for the Youngstown, Ohio, plant of the Jones & Laughlin Steel Corp. Succeeding him as supervisor of quality control is William Brenner, Jr. (right). Nelson has been with J & L since 1947. Brenner, a research engineer since 1945, served as service metallurgist until his recent appointment.

Men at Work

MIN WEINER, a New Brunswick attorney, and HENRY S. BRIGHTMAN, executive vice president and general manager of L. J. Wing Mfg. Co., Linden. Hudson is a specialist in shock wave studies and a pioneer in the area of macrosonics. Boucher, who heads the ultrasonic laboratory of New York University's research division, is a consultant to several European and North American firms in the fields of airborne sound and ultrasonic applications.

Newly-appointed manager of the automation and parts handling equipment department at Synton Co., Homer City, Pa., is J. W. PHILIPPOVIC. In this position, he will supervise research, development, production and sales of the company's automation equipment.

GEORGE G. BROOKS has been appointed director of industrial systems at Consolidated Systems Corp., Monrovia, Calif. He will direct operations of a group specializing in industrial systems for the utilities, metals, process and petrochemical industries.

EDWARD G. SCHROEDER, in his new position as vice president and director of Electric Products Co., Cleveland, Ohio, will be in charge of all engineering and sales, including all research and development and VarEPack activities.

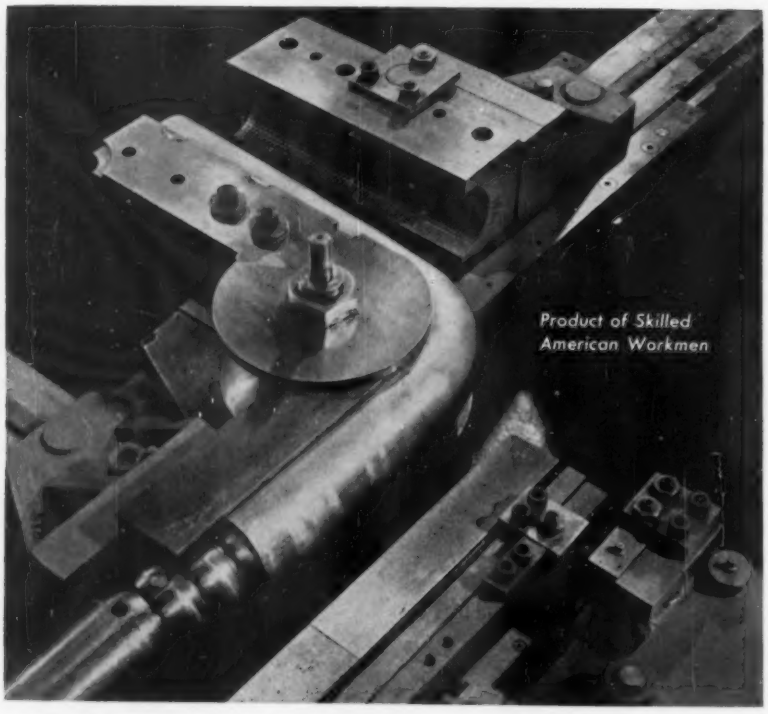
Appointment of PAUL M. NASH as manager of Chrysler Corp.'s Mound Road Engine Plant has been announced by A. W. Hartig, general manager of the company's engine, axle and transmission plants. Nash has held positions in the power train group and in the axle and transmission division.

JULS MILLER and EDWARD E. WILLIAMS have been appointed to the positions of head of the electromagnetic devices department and manager of the design and development section, respectively, of Schaevitz Engineering, Pennsauken, N. J. Miller, who invented the first radio timer, was formerly associated with Schick Electric Shaver Co., Lamb Electric Co. and Decker Corp. He has also been professor and chief of engineering at Depoge College, Berlin, Germany. Williams, in his newly-created position, will be responsible for all new product designs, associated drafting requirements and engineering reports, as well as the modification of all existing product lines to meet specific customer demands. He has held past posts with Benjamin Lessner Co. and with C.D.C. Controls, Inc.

DAVID CRENSHAW and IRVIN ANDERSON will head the newly-established technical service division of Merendino/Greene and Associates, Inc. The division will provide an engineering and laboratory supplement to the firm's design services.

Appointment of Emil F. Peslar as vice president of manufacturing has recently been made by American-Standard Industrial Div., Detroit, Mich. Peslar replaces R. S. Reade. Peslar's previous posts have been with Chrysler Corp., General Motors Corp., and Borg-Warner Corp.

COLUMBIA
TOOL
STEELS



TOOL STEEL IN USE: Tooling for Tube Bending Operation

Operation makes wrinkle-free bend on 3½" centerline radius with .020" thick aircraft quality 3" diameter stainless steel.

Three ball mandrel and wiper die are of SUPER-DIE. Bending, form and clamp dies are of E-Z-DIE.

It Pays to Use Good Tool Steel

COLUMBIA TOOL STEEL COMPANY
450 Lincoln Highway
Chicago Heights, Illinois

E. W. Bliss Co., New York, has elected George T. Pfifer to the office of vice president, assistant to the president. Pfifer, for the past four years, has been vice president of finance and, prior to his association with Bliss, was treasurer of National Can Corp. Appointed as a director of the company was Clifford Childress, president of John Robertson Co., Brooklyn, N. Y. The Robertson Co. is a wholly-owned subsidiary of Bliss.

ROBERT M. LYNAS has been named operations manager of the Thompson Ramo Wooldridge, Inc., Michigan division. He will have responsibility for the Van Dyke, Portland and Federal works. For the past year, Lynas has been serving as manager of the Michigan division of the Hydraulic Products Works in Cleveland, Ohio.

WILLIAM H. GRINOLD, vice president of operations, has been elected president of Wallingford Steel Co., Wallingford, Conn., a subsidiary of Allegheny Ludlum Steel Corp. He succeeds EDMUND B. CLEBORNE, founder of the company. GUY CLEBORNE, in addition to his office of treasurer, will become a vice president.

LOUIS C. LUSTENBERGER, president and board member of W. T. Grant Co., has been elected to the Board of Directors of the Nylok Corp., Paramus, N. J. Lustenberger has served as vice-president and board member of Montgomery Ward & Co. and, prior to his present office as president, as executive vice-president and general manager of W. T. Grant.

ALAN J. ROWE has been appointed manager of research in Hughes Aircraft Co.'s industrial dynamics department. In this position, he will analyze the company's total business system, adapting economic and management techniques developed through his research in business operations and econometrics. Prior positions have been with System Development Corp., General Electric Co. and Rand Corp. He has also been an assistant professor of industrial engineering at the University of Southern California.

HARRY L. HILDEBRAND, formerly manager of the fabricating division of Taylor Fibre Co., Norristown, Pa., has been named manager of process and design engineering. JOHN G. MUSSELMAN, JR., formerly general machining foreman at SKF Industries, has been appointed manager of the fabricating division, succeeding Hildebrand. Hildebrand will assume responsibility for introducing new production methods and for the design of equipment used for development and manufacture in the company's three plants.

CHARLES G. CHISHOLM, sales manager of Haynes Stellite Co., a division of Union Carbide Corp., New York, has been appointed vice president in charge of marketing.

Clearing Div., U.S. Industries, Inc., Chicago, has announced the appointment of BJARNE C. BENDICSEN as chief electrical engineer and W. H. STOUT as vice president and comptroller.

ON YOUR PRODUCTION LINE

Get pressure where you need it with a

HANNIFIN
FORCING PRESS

150 TONS to 1 TON
•
GAP OR COLUMN TYPES
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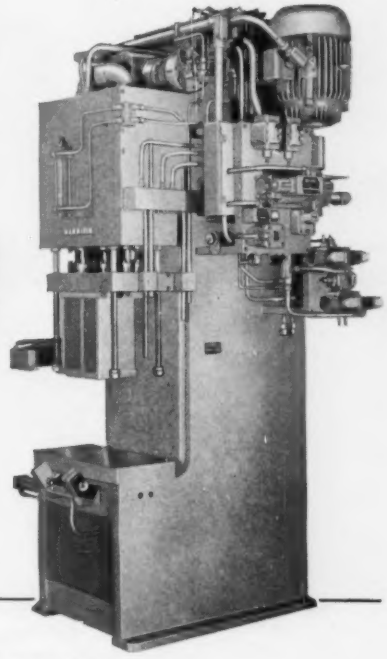
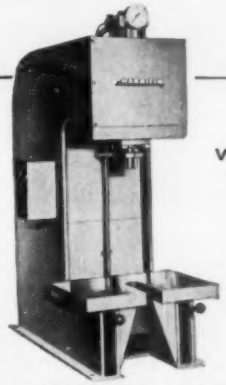
HIGH SPEEDS · LOW PRICES





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1. All-steel welded frames—normalized.
2. Steel-head, heavy-duty cylinders.
3. Induction case-hardened rams.
4. Wide choice of ram speeds.
5. Built-in power units.
6. Wide choice of controls.
7. Special loading and unloading mechanisms where needed.

Call in your nearby Hannifin man—he's a trained production analyst—find out how you can do more at lower costs with Hannifin presses. Or, write for our new Bulletin 130-G. It tells the whole story.

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PNEUMATIC AND HYDRAULIC SYSTEM COMPONENTS

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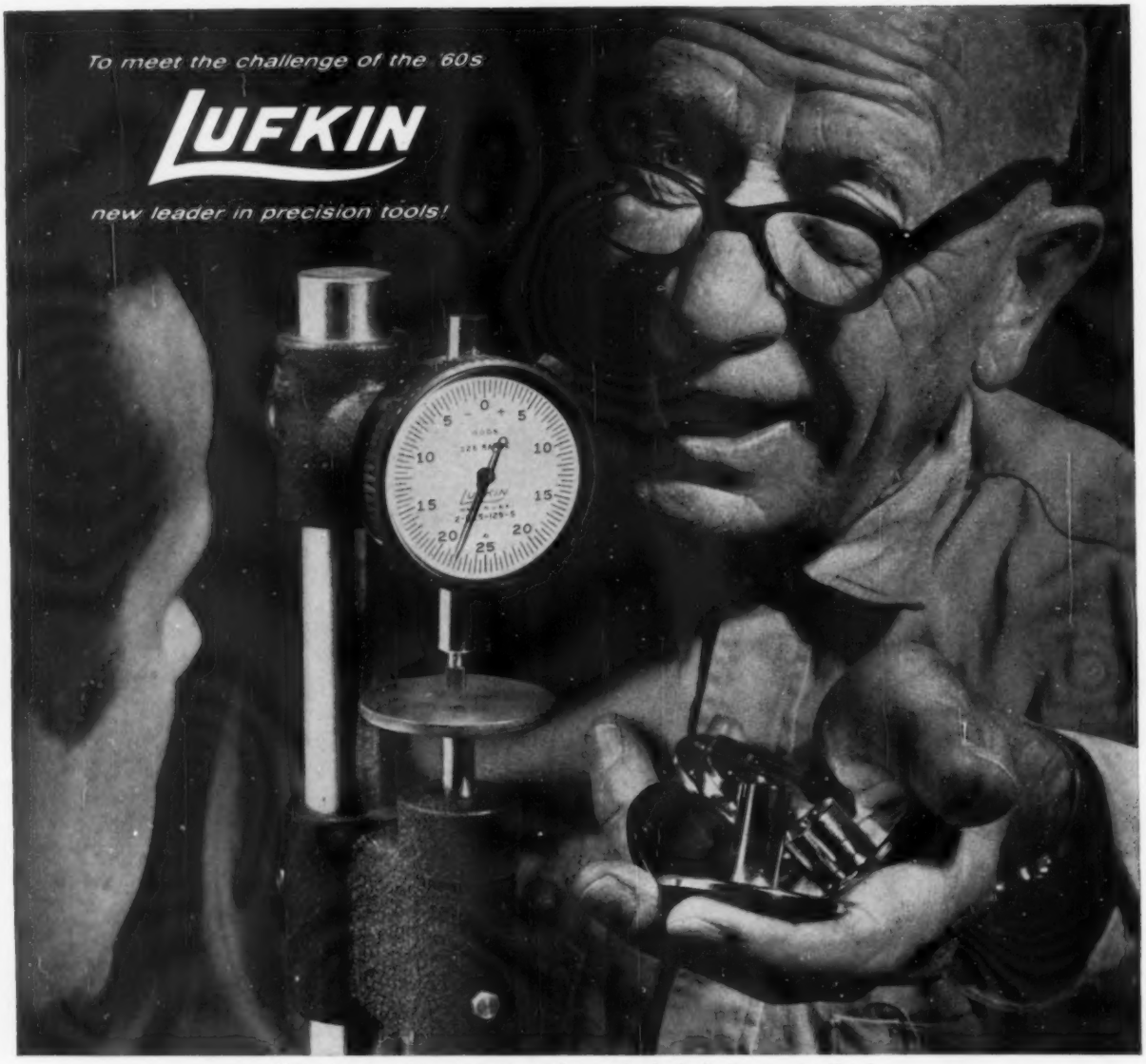


"The fabulous '60s, with tremendous technological advances predicted, will require this type of perfectionist precision tool . . . and, son—

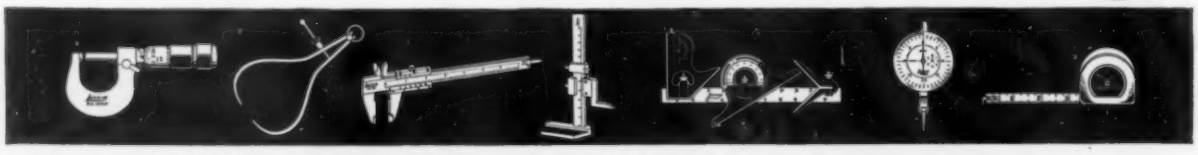
Here's why Lufkin indicators stay on the job!"

You'll seldom see them in the repair shop, because Lufkin dial-test indicators are made with one-piece forged-brass bodies. Movements are inserted from the top. So dirt *can't* get inside!

No die castings are used for any moving parts. The pivots, gears, racks and pinions are made of stainless steel for rust and wear resistance. Full jeweled or plain bearings. All Lufkin indicators are designed to AGD standards. And if it is ever necessary to repair a Lufkin indicator, the job is "ABC" simple.

There's variety of interchangeable backs—regular, post, adjustable, screw bracket—and a universal back which permits 180° arcs and 360° turns for unlimited range of indicator settings.

See your industrial distributor. He knows precision tools and can show you how Lufkin leads in design and craftsmanship. His stock is maintained to fit your needs. LUFKIN, Saginaw, Mich.



Field Notes

Two new technical advisory committees have been established by the **National Bureau of Standards** of the **U. S. Dept. of Commerce.** The **Advisory Committee on Calibration and Measurement Services** will advise the bureau concerning current and anticipated needs of industry and suggest how the bureau can best be utilized toward meeting them. The **Advisory Committee on Engineering and Related Standards** will concern itself with national needs for codes, specifications, standard test methods and standard data on the properties of engineering materials; maintain contact with private organizations working in these areas; foster cooperative programs; and make recommendations concerning the development of standards by the bureau. William Wildhack, Special Assistant to the NBS director, is chairman of both committees.

new facilities

Ajax Composite Die Co., Detroit, Mich., has begun construction of a plant which will double the company's facilities. The single-story 13,000-sq ft building is scheduled for completion on Feb. 1, 1961.

Allis-Chalmers Mfg. Co. has announced plans for a 650 x 56-ft addition to Plant 2 at its York (Pa.) Works. The addition will provide an extra 36,000 sq ft of production area.

Autonetics, a division of **North American Aviation, Inc.,** has opened an integrated industrial products facility in Long Beach, Calif. It includes administrative, marketing, quality control and engineering sections and provides for the manufacture of electronic equipment for industry.

Hamilton Standard Div., United Aircraft Corp., has announced the formation of a scientific laboratory to undertake research on existing and advanced product programs. The facility, now under construction at Windsor Locks, Conn., will centralize and enlarge the company's research activities both in and outside the aerospace field. The division has extensive operations in the areas of jet aircraft, missiles and space systems and industrial products.

Ground was recently broken for the first stage development of a multimillion dollar electronics center for the **Bendix-Pacific Div.** on an 80-acre site in the northern San Fernando valley. The $3,700,000 center will be ready for occupancy next summer. The first building to be constructed will be used primarily for electronic production. An adjacent building will house sonar testing facilities, including a 75 x 35 x 35-ft tank with a capacity of 50,000 gal of water.

acquisitions

Effective Jan. 1, 1961, **Bound Brook Oil-Less Bearing Co.,** Bound Brook, N. J., will become a wholly owned subsidiary of **Birfield, Ltd.,** of London, England. The American corporation, a manufacturer of bearings and structural parts for industrial and commercial applications, will change its name to **Bound Brook Corp. of America.** Birfield, Ltd., consists of a group of 15 companies in England with associated companies in France, Sweden, Germany, Australia and India.

Grimes Engineering Corp., Cheshire, Conn., designers and manufacturers of machine tool accessories, has acquired **LeCount Tool Works, Inc.,** of Hartford. LeCount produces high-precision expanding mandrels and other workholding fixtures.

Dynapar Corp., Skokie, Ill., has been purchased by the **Louis Allis Co.,** of Milwaukee, Wis. John W. Allis, president, views the acquisition as being "of particular significance because it marks our entry into the field of electronic equipment. . ." Dynapar manufactures preset digital controllers, transistorized clutch position compensators, length controllers, draw elongation and speed indicators and transducers.

The **Cleveland Punch & Shear Works Co.,** Cleveland, Ohio—manufacturer of mechanical power presses, fabricating machines for structural steel and steel plate, and punching tools and dies—has been purchased by the **Ohio Forge & Machine Corp.** Charles E. Thayer, president of Ohio Forge, will hold the same office at Cleveland Punch & Shear.

new activities

Racine Hydraulics & Machinery, Inc., Racine, Wis., plans to augment its present research and development staff with the services of a four-man scientific board headed by Milton Goldstein, dean and director of research of the American Institute of Engineering and Technology, Chicago, Ill. Other members are Charles Watson, chemical engineering department, University of Wisconsin; C. Charles Miesse, a specialist in fluid mechanics and applied physics, Armour Research Foundation, Chicago, Ill.; and Samuel E. Rusinoff, professor of manufacturing processes, Illinois Institute of Technology, Chicago, Ill.

A new unit for the design and manufacture of press brake tooling has been formed by the **Valeron Corp.,** Detroit, Mich. It will be housed in a newly constructed 17,000-sq ft plant in Addison, Ill.

expansions

Formation of an associate company in England to manufacture, sell and service Red Ring gear production equipment, ball screws and boring heads to British, European and world markets is announced by the **National Broach & Machine Co.,** Detroit, Mich. The new company, **Precision Gear Machines & Tools, Ltd.,** is located in Coventry, England. It was purchased from **Birfield Tools, Ltd.**

Plans for the construction of a coated abrasives plant in Australia have been made by **Minnesota Mining & Mfg. Co.** To be located at St. Mary's, New South Wales, the plant will have 40,000 sq ft of floor space. It is expected to be in production in early 1962.

name changes

Stauffer-Temescal Co., Richmond, Calif., has changed its name to **Stauffer Metals Co.** At the first of the year, it will also become a wholly owned subsidiary of **Stauffer Chemical Co.,** New York.

Arrow Tool Co., Wethersfield, Conn., recently changed the name of its engineering division from **Mech-Tron Instrument Corp.** to **Mech-Tron Engineering Corp.** Expanded services, covering engineering from tool design through the product design, develop-

ment and production phases of mechanical, electromechanical and electronic equipment, were factors determining the name change, according to president David T. Dewhurst.

moves

Philips Metalonics, producer of dispenser cathodes and machined tungsten parts, has moved its divisional headquarters and production facilities into a new building at 888 S. Columbus Ave., Mount Vernon, N. Y. Formerly operations were carried out at Irvington-on-Hudson, N. Y. Roberto Levi will continue in the capacity of technical director and Robert Vachon has been appointed sales manager.

association news

Frank W. Reynolds, International Business Machines, Endicott, N. Y., has been elected 1961 president of the **Society of Plastics Engineers.** Other officers elected include vice-president (engineering), James R. Lampman, General Electric Co., Syracuse, N. Y.; vice- president (administration), John Delmonte, Furane Plastics Co., Los Angeles, Calif.; secretary, Maurice F. Malone, Canadian Resins & Chemical Co., Shawinigan, Quebec; and treasurer, John Berutich, Haveg Industries, Louisville, Ky.

The appointment of five new members to the planning council of the **American Management Assn.'s** manufacturing division has been announced by Lawrence A. Apply, president. They are Harry G. Beggs, vice president of manufacturing, International Telephone and Telegraph Corp., New York, N. Y.; C. J. Lawson, Jr., director of manufacturing services, International Business Machines Corp., New York, N. Y.; Milton E. Morgan, vice president and general manager, Permaglas Div., A. O. Smith Corp., Kankakee, Ill.; Chester F. Ogden, vice president, Detroit Edison Co., Detroit, Mich.; and George A. Peck, president, Southwestern Industrial Electronics Co., Houston, Tex.

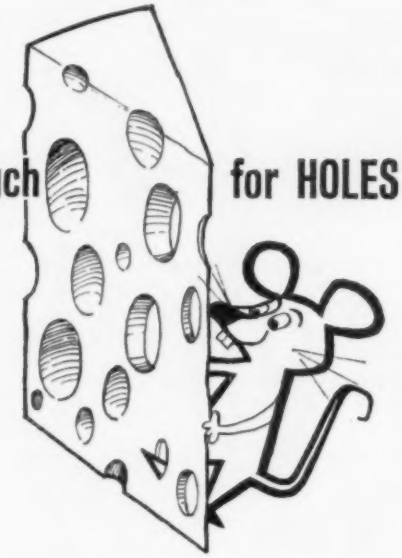
Details of its 1961 contest for skills in the various arts and crafts involved in the production of metal castings have been announced by the **American Foundrymen's Society,** Des Plaines, Ill. The winners will be awarded cash prizes of $50 to $100 and be given trips to the AFS Castings Congress and Exposition in San Francisco. To be eligible, contestants must have been in the castings industry not more than four years for metal molding or five years for patternmaking. Names and entries of local contest winners for national judging must be received at the University of Illinois at the Navy Pier, Chicago, no later than Mar. 31, 1961. Copies of rules and regulations are available from AFS headquarters in Des Plaines, Ill. or from local AFS chapter officers.

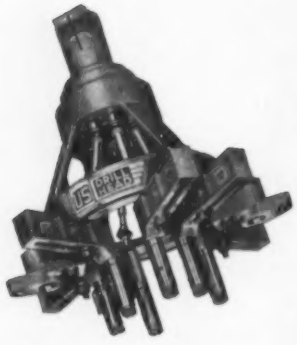
Stewart W. Pollock, Dexco Corp., Detroit, Mich., has been named president of the **Solid Carbide Tool Institute** for the year 1960-61. The Walter Gebhart Organization, Philadelphia, Pa., was reelected secretary-treasurer.

The **American Foundrymen's Society** training and research institute has commissioned the Franklin Institute, Philadelphia, Pa., to conduct original research in the field of heat transfer. Aim of the program will be to evaluate heat flow from high-temperature molten metals as it occurs during the casting process.

Recognition of the role which ductile iron plays in the gray iron foundry industry was made through the establishment of a **Ductile Iron Committee by the Gray Iron Founders' Society, Inc.** Members of the committee are John W. Perry, Jr., Grede Foundries, Inc.; Hermann P. Good, Textile Machine Works;

Spending too much for HOLES?





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Edward L. Roth, Motor Castings Co.; Robert W. Jordan, Hamilton Foundry Co.; George H. Tompkins, The Black-Clawson Co.; Charles A. Glenn, Lynchburg Foundry Co.

Samuel Steingiser, assistant director of research, Mobay Chemical Co., New Martinsville, W. Va., and Edwin A. Edberg, Koppers Co., Inc., Monaca, Pa., have been reelected chairman and vice-chairman, respectively, of the **Cellular Plastics Div.** of the **Society of the Plastics Industry, Inc.** They will serve for the next two years.

United Engineering Trustees, Inc., an organization of five major national engineering societies, has announced the election of Willis F. Thompson, as president. Thompson, executive vice president of Westcott and Mapes, Inc., New Haven, Conn., succeeds Andrew Fletcher. Fletcher is now assuming Thompson's former post as chairman of the UET real estate committee. Elected to the offices of vice president were James F. Fairman, senior vice president, Consolidated Edison Co., New York, and L. C. Kemp, Jr., vice president, Texaco, Inc., New York.

At the recent meeting of the **Council of the International Organization for Standardization** held in Geneva, Switzerland, five new international standards projects were approved and technical committees created. Standards for digital computers and data processing machines are among the projects.

awards

A citation for the research and development of **Hi-T-Lube was awarded to General Magnaplate Corp.** by the **Air Force Association.** A multilayer solid film lubricant, Hi-T-Lube was developed to meet the high temperature requirements of new designs in aircraft, missiles and spacecraft.

Joseph G. Rayniak recently received the **Society of Die Casting Engineers** award for outstanding achievement in the field of die casting. He is vice chairman of the board of directors of manufacturing research for the Outboard Marine Corp., Waukegan, Ill.

For outstanding service to the contract tool and die industry, Jack Kleinoder, secretary and treasurer of Volkert Stampings, Inc., Queens Village, L. I., N. Y., was presented the L. A. Sommer Memorial Award by the **National Tool, Die & Precision Machining Assn.** Kleinoder, active in the association since its founding, served as its president in 1958-59 and has filled various other offices. For a number of years, he served as chairman of the apprenticeship committee.

James Finney Lincoln, chairman of the board, Lincoln Electric Co., Cleveland, Ohio, was cited by the **National Electrical Manufacturers Assn.** for outstanding leadership and inspiration in the creation and development of the electric arc welding process and industry. He received the James H. McGraw Award. Lincoln was also cited for his leadership in organizing welding schools and engineering seminars as well as in establishing the James F. Lincoln Arc Welding Foundation.

Winners of the two highest standards awards for 1960 were recently announced by the **American Standards Assn.** Richard C. Sogge, General Electric Co., received the Standards Medal. The Howard Coonley Medal was awarded to J. H. Foote, Commonwealth Associates, Inc., New York. The medals were presented October 26.

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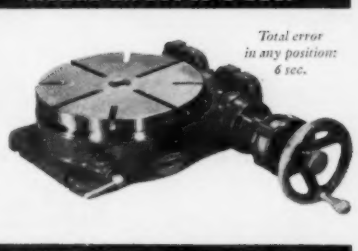

Total error in any position: 6 sec.

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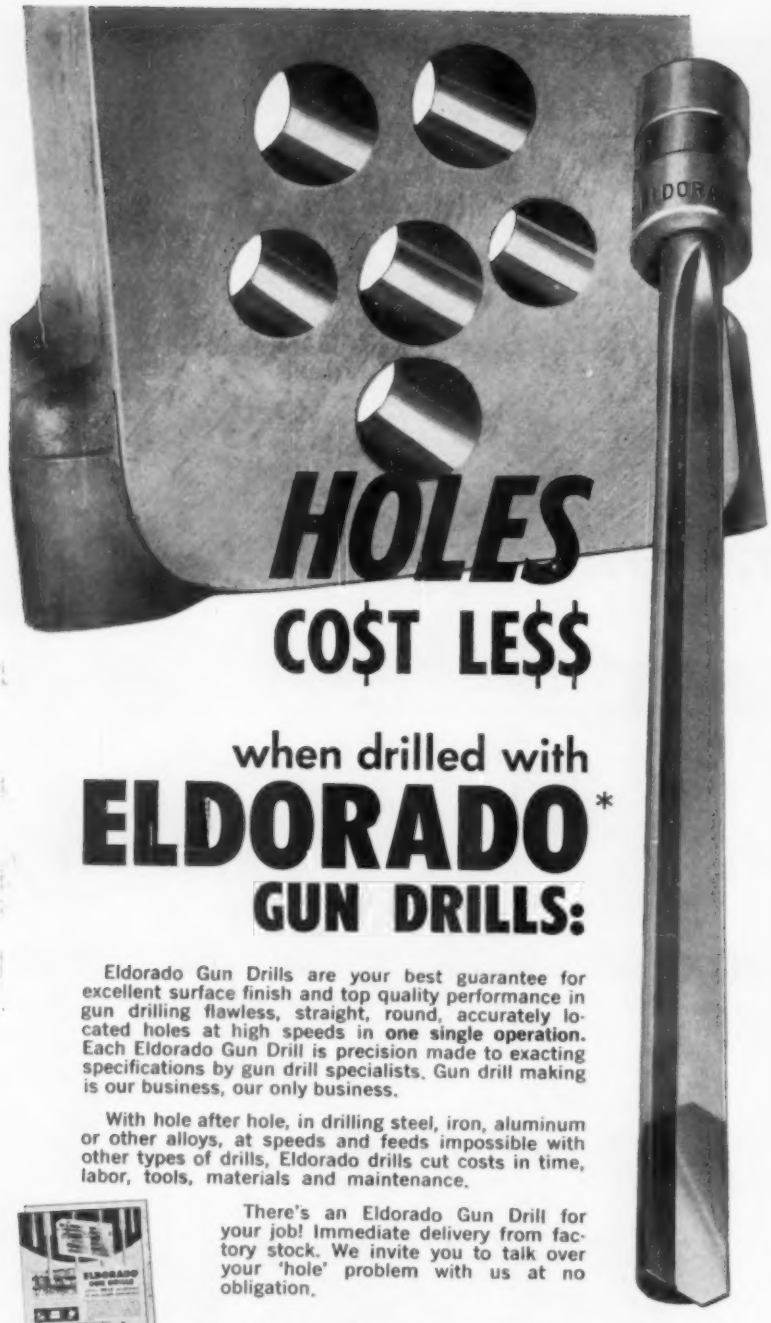

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ENGINEERING BOOKSHELF

WRITING THE TECHNICAL REPORT—*By J. Raleigh Nelson. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $5.50. 356 pages.*

Engineers confronted with the task of writing technical reports are often overwhelmed by a sense of personal inadaquacy. Recognizing this fact, and the fact that our increasingly complex technology makes report writing a professional prerequisite, Professor Nelson has outlined a scientific method of writing technical reports. Significantly, the author is Professor Emeritus of English in the College of Engineering at the University of Michigan.

Content of the book is divided into five parts, the first of which is "Design of the Report." This treats the structure of the report, showing the manner in which it can be constructed by an algebraic sequence. This is of special importance since many engineers experience difficulty in organizing and presenting their material in a logical manner. The remaining four sections of the book provide suggestions for form and style, criticism, a summary of basic principles and a manual for class use.

Engineers will be gratified to know that polished literary style is not essential to the writing of good reports. The attributes most desirable are clarity, directness and brevity, characteristics which engineers, by the very nature of their work, are most apt to possess.

THE CRISIS WE FACE—*By George Steele and Paul Kircher. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $4.95. 220 pages.*

Normally the only books reviewed by this department are those which can be classified as engineering texts. This one we think is important enough to be made an exception to the rule especially since its basic topic is automation. The authors' thesis, quite simply, is that we face a crisis because modern automation, particularly weapons automation, is too complex to be an effective Cold War tool. Cited as a prime example of hypercomplexity in automa-

tion is the high percentage of failures in our missile program. These failures, in the authors' opinion, can be attributed to the lack of centralized controls in the various components that make up the missile as a whole.

Another defense weakness cited is that of our computers. In long range bombers for example, the device which manages the fuel must be a highly sophisticated equation solver, considering the variables involved. The question of whether an analog or digital computer is best suited for this problem arises, but in the authors' opinion neither type as presently designed is suitable to this and similar applications.

Management, as it exists today, is also given short shrift by the authors. Really good administrators are in short supply and those available are "programmed by their telephones." Administrative lines are short-circuited by endless delay and little time is reserved for the comtemplation necessary to successful administration at the policy-making level.

The solutions offered to these and other problems which constitute the envisioned crisis are more efficient automation and computers, standardized system components, reorganization of management functions and greater emphasis on research and education. These we truly need, but whether or not the authors have overstated their case only time will tell. We believe, however, that their book is timely and deserves the attention of today's engineers.

CAM AND TOOL DESIGN—*Published by Brown & Sharpe Precision Center, Providence 1, R. I. Price $7.50. 81 pages.*

Written to supplement three previous books, *Construction and Use of Automatic Screw Machines, Brown & Sharpe Cam & Tool Design Tables and Brown & Sharpe Screw Machine Tools Catalog,* this book explains the procedure required to solve cam-design problems. Topics treated include estimating, layout, turret tooling and cam design for all screw-machine operations.

BOOK COMPUTER—*Published by Metron Instrument Co., 432 Lincoln St., Denver, Colo. Price $15.00. 999 pages.*

Basically a set of multiplication tables through 999 times 999, this book is an excellent substitute for the slide rule in making rapid-fire calculations. Instructions provided enable the user to find answers to multiplication and division problems by turning to the correct page and column. Squares, cubes, square and cube roots, logarithms and multiplication of numbers by Pi are also available. Compiled by electronic computing equipment, this book provides accurate answers to six places.

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To the Editor:

This is in reference to your editorial in the October issue of THE TOOL AND MANUFACTURING ENGINEER. Several things about the editorial "What Incentives Work?" seem to me to call for some comment. I wonder if you plan to follow this up with one or more articles having to do with profit sharing or some other form of incentive. Incentives do not necessarily call for excessive administrative costs nor for endless discussion of trivia. In fact, many good incentive systems make considerable use of data which a well-run plant should already have. In many cases the data collected for incentive systems is also used for many other purposes such as scheduling or cost control.

I am also somewhat puzzled by comments which infer that a group of workers within the plant are studying other systems of pay and have organized for the purpose of pursuing the idea of profit sharing. This raises in my mind the image of these workers getting together to decide among themselves what the best method of payment would be and then perhaps trying to convince management that this is the way in which they would like to be paid. Perhaps this was the intention of your editorial. In any event, certainly long years of continuous service need to be recognized and rewarded and certainly such loyal employees do have a large investment in their company.

I hope you will follow up this editorial with something which amplifies on the questions which you have raised in this first editorial. . . .

R. G. Carson, Jr.
Director of Instruction
School of Engineering
North Carolina State College
Raleigh, N. C.

The purpose of this editorial was to remind engineers and managers that worker morale and worker motivation are important factors in industrial productivity. Determining the methods of rewarding worker effort and initiative is, of course, a management prerogative. Some companies that have tried incentive plans have had outstanding results in terms of increased efficiency. For this reason, we believe incentive plans are worthy of study by labor and management alike.—Ed.

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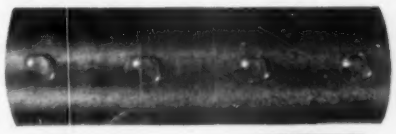

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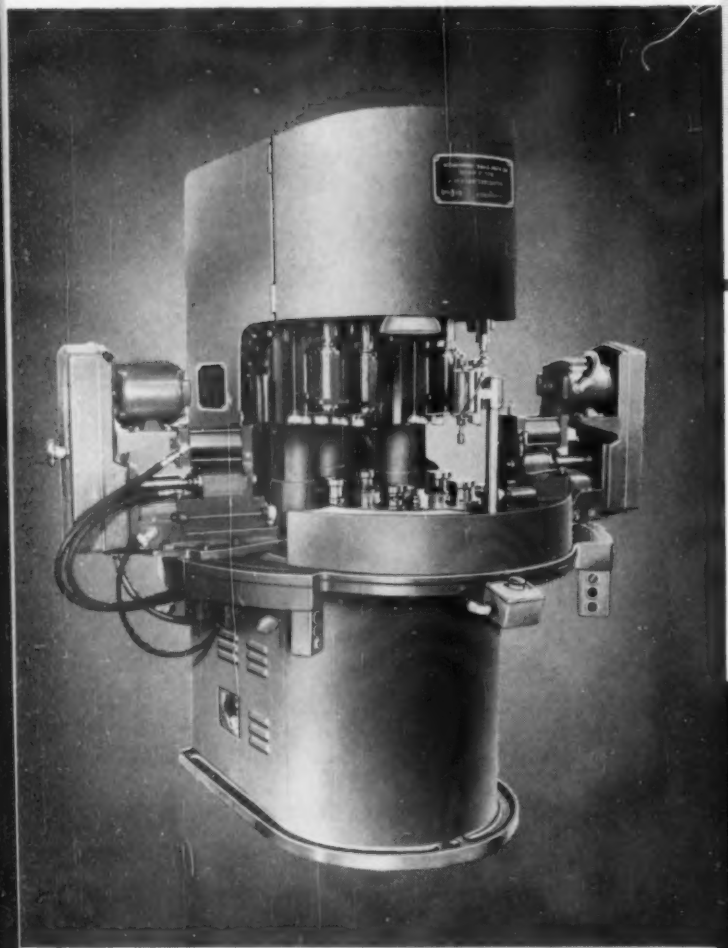
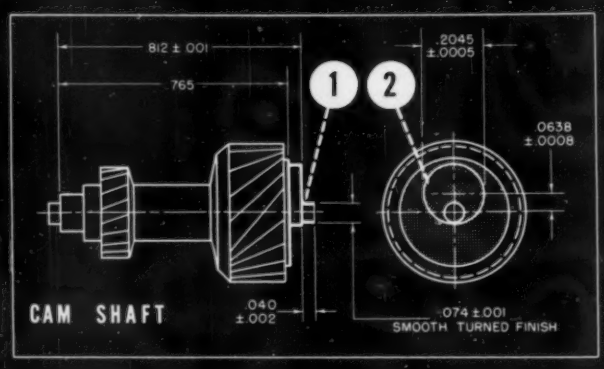


STANDARD TOOL'S *NEW* 2nd Operation Machine

says **Bill Iversen**

at Bell & Howell Co.

"Never before has a machine tool investment paid off so fast. This new machine, in addition to proving itself on our eccentric cam shaft, is so easy to set-up that it now handles an entire group of second operation work. Our methods department is still finding new jobs to process thus increasing its usefulness in our continual cost reduction program. This Standard Tool machine has conclusively established itself as one of the most profitable pieces of equipment we have ever installed."



PROBLEM:
To reduce the high cost of producing one of our precision eccentric cam shafts which required over 2 minutes of hand screw machine time to chuck and turn the eccentric.

OPERATIONS PERFORMED

① Turn to .074" ± .001 dia. and face to .812" dim.

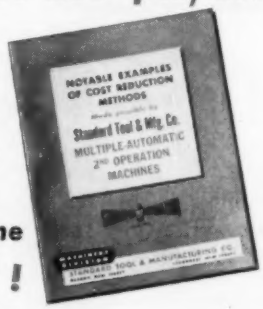
② Eccentric turn .2045" ± .0005 and face to .765" dim.

New precision machine tool performs multiple secondary operations simultaneously at 286 pcs/hr.

● With the *Standard Tool* automatic chucker, Bell & Howell's actual production time for this turning operation was reduced 90%.

Find out how the *Standard Tool* automatic chucking machine can help you realize savings too. Please send your part prints and allow our methods engineers to prove conclusively the savings you can realize. We will be pleased to demonstrate the machine's ease of set-up, versatility, accuracy, and cost reduction ability.

This Free Book details 30 typical cost-saving examples using Standard Tool 2nd Operation Machine



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Trade Literature

for free booklets and catalogs—use request card, page 183

ENGINEERING FEATURES and production capabilities of automatic high-speed ribbon and wire forming machines are explained in a catalog which also shows ribbon and wire parts which can be produced on the machines. Baird Machine Co. **(Circle 501)** . . . Brochure describes a line of air-operated tangent bending machines, illustrates special bender designs and gives a chart which correlates bending radius with flange height. Taylor-Winfield Corp. **(Circle 502)** . . . A multitool machine that drills, taps, bores, reams and mills through numerical control and several of its applications are described. Cleereman Machine Tool Corp. **(Circle 503)**

Automation, Mechanization

Static control for machine tools which provides computerless contouring or absolute positioning or both is described. General Electric Co. **(Circle 504)** . . . Six ways to simplify control design are shown in a bulletin which illustrates various analyzer models used for problem solving in servo system design, debugging, production, teaching and testing. Also described is a method of servo system synthesis and infrared radiation detection. Servo Corp. of America. **(Circle 505)** . . . An infrared photoelectric control which functions by reflected or interrupted beam over a long range even under high general light conditions is covered in a catalog. Also presented are typical materials handling, counting, inspection and control installations and detailed specifications and descriptions of models and accessories. Cramer Controls Corp. **(Circle 506)**

Boring, Drilling, Tapping

A bulletin describes an air-operated cam contouring machine, giving its features and complete specifications. The machine has a 4-inch cam controlled stroke on both main and cross slide and is designed for production boring, turning, contouring and facing operations. Olofsson Corp. **(Circle 507)** . . . A 28-page tracing template set includes templates illustrating standard stocked boring bars to aid designers and process engineers in determining the correct size and length boring bar for given applications. The set comes complete with an index and full-scale diagram which indicates actual bar size and relative position of preformed triangular shaped tool bits in each bar. Everede Tool Co. **(Circle 508)** . . . A layout drilling machine is designed to meet requirements where the precision of a jig borer is unnecessary. Cleereman Machine Tool Corp. **(Circle 509)** . . . Achieving the cost-reducing advantages of numerically controlled drilling with relatively low-cost equipment investment is covered in a catalog of sliding head drilling machines. It also describes the programming and tape control method of automatic table positioning. Cincinnati Lathe and Tool Co. **(Circle 510)** . . . Eight-page catalog describes and illustrates a six-turret numerically controlled machine which controls tool selection, feed, spindle speed, hole depth and tapping cycle. Cincinnati Lathe and Tool Co. **(Circle 511)** . . . A numerically controlled lathe, its general specifications, standard and optional equipment and the method of programming the lathe are described in a catalog. Cincinnati Lathe and Tool Co. **(Circle 512)** . . . A horizontal boring machine with dynamic precision control is covered in a 20-page catalog. Bullard Co. **(Circle 513)** . . . A bulletin illustrates and describes a bench model automatic 6-spindle turret drilling and tapping machine which is equipped with power feed and a rapid manual positioning table. Burgmaster Corp. **(Circle 514)** . . . A radial drill, designed for a wide range of drilling, boring and tapping operations is described in a booklet. Design features, operating advantages, capacities and specifications of the machine are also covered. Giddings & Lewis Machine Tool Co. **(Circle 515)**

Casting, Molding

The techniques of gating zinc die castings are described in a booklet. Also discussed are multiple cavity arrangements, runner and sprue details, overflow well details, gating and die temperatures and methods of avoiding soldering of the die. American Smelting and Refining Co. **(Circle 516)** . . . Three bulletins deal with finishing oven efficiency, foundry ovens with horizontal air recirculation and general oven facts. Michigan Oven Co. **(Circle 517)**

Cleaning, Painting, Plating

A metal parts chemical cleaner for finishing parts made of stainless steel, brass, aluminum, carbon steel, nickel and nickel alloys and other materials is described in a brochure. Pall Corp. **(Circle 518)** . . . An eight-page booklet lists varied engineering applications of plating process and discusses problems solved by its use. Selectrons, Ltd. **(Circle 519)** . . . Eighteen electroplating processes, including three nickel processes and two conversion coating processes, are described in a bulletin. Hanson-Van Winkle-Munning Co. **(Circle 520)** . . . The way in which an impeller uses controlled centrifugal force for its blast cleaning power is described in a bulletin. Pangborn Corp. **(Circle 521)**

Electric Motors, Controls, Drives

Design features, performance characteristics and the size range of a redesigned line of squirrel cage induction motors are described in a bulletin. Lincoln Electric Co. **(Circle 522)** . . . An eight-page publication compiled for original equipment manufacturers of tracer, contour and numerical positioning control, machine tools and metalworking machines describes features and advantages of machine tool motor-generators for use in feed drive power supply systems. Charts of operating characteristics, typical connection dimension diagrams, and special design and performance data including curves for output current and voltage at various control field excitation values, stored energy values and standard typical saturation curves are also given in the booklet. General Electric Co. **(Circle 523)**

Trade Literature

Fastening, Joining

Standard and special spring fasteners in twin-prong or cone type impressions and push-on types are illustrated in a catalog. Selection data and information concerning tensile and torque and other pertinent design requirements are provided. George K. Garrett Co. **(Circle 524)** . . . A 12-page catalog lists the uses, characteristics and general properties of over 170 different adhesives, coatings and sealers. A cross reference index lists over 200 different adhesive, coating and sealer applications and refers to the section of the catalog where a product will be found for each of these specific applications. Minnesota Mining and Mfg. Co. **(Circle 525)**

Finishing, Grinding

A shake-free dresser which permits dressing a grinding wheel to exactly the same shape as the profile bar without honing or modifying the profile bar in any way is described in a bulletin. Landis Tool Co. **(Circle 526)** . . . Photographs, diagrams and specifications for a complete line of diamond dressing tools and catalog inserts covering loose industrial diamonds, diamond compounds and pressure-tested powders, saw blades for masonry and concrete, masonry drilling bits, mining bits and diamond grinding wheels are offered in a catalog. One section discusses the selection of the right type of diamonds necessary for different grinding wheel dressing applications. Diamond Tool Research Co. **(Circle 527)** . . . A bulletin describes a new concept of dressing abrasive wheels and contains illustrations of an electronically controlled power-driven circular dressing used in dressing grinding wheels. Sidley Diamond Tool Co. **(Circle 528)** . . . A disk calculator gives easy-to-use instructions on how to find the surface speed in feet per minute of any wheel from 1 to 60 inches in diam, turning at spindle speeds from 220 to 20,000 rpm. Hanson-Van Winkle-Munning Co. **(Circle 529)** . . . A four-page brochure includes specifications, data and illustrations of machines for deburring, deflashing, grinding, descaling, polishing, burnishing or drying unfinished parts. Syntron Co. **(Circle 530)** . . . Bearing races or rings for precision mechanisms can be OD ground within the closest limits for concentricity on a concentric grinder. Landis Tool Co. **(Circle 531)** . . . An 8-page catalog describes and illustrates an improved precision surface grinder. Landis Tool Co. **(Circle 532)** . . . Semiautomatic cylindrical grinders are covered in a bulletin which also lists standard equipment, specifications and features. Landis Tool Co. **(Circle 533)** . . . Plain cylindrical grinders are illustrated and described in a 6-page bulletin. Landis Tool Co. **(Circle 534)**

Fluid Power

Data and recommended use for eleven straight distilled oils with viscosities ranging from 55 SUS at 100 F to 140 SUS at 210 F for hydraulic and circulating systems operating below 120 F; where oil is constantly being replaced because of leakage; or where earth filters are used to remove contamination and recondition the oils for extended use are given in a bulletin. Sun Oil Co. **(Circle 535)** . . . A midget torque actuator for use in instruments, computers, or switches or for operating small valves using hydraulic or pneumatic pressure to produce rotary reciprocating movements is described, giving complete descriptive information, a mounting drawing and engineering data, in a four-page folder. Ex-Cell-O Corp. **(Circle 536)** . . Principles of construction and operation

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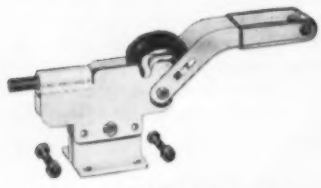

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Hand Push-and-Pull Swivel-Base Clamp

AOP&P-1200
Push-and-Pull Air-Operated Clamp

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90° handle motion produces lock of plunger for push or pull without resetting of handle. Handle is reversible. Plunger guided by two widely separated, hardened steel bushings for accuracy in motion and minimum wear. Built-in deflection provides uniformly tight clamping of parts with normal variation in thickness. Swivel base model provides 90° total change in direction of plunger motion. The air (or oil) operated model, AOP&P-1200, produces approximately 4½ times the clamping force with 85 p.s.i. than the cylinder would alone. Failure of air (or oil) pressure does not permit reverse motion of plunger, thus not affecting clamping force.

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as well as advantages of a line of non-rotating air cylinders with a large center hole for operating air and collet chucks are contained in a circular. PowerGrip, Inc. **(Circle 537)** . . . A 6-page brochure describes packaged hydraulic systems for process control of various operations, including heat-treatment. Vickers, Inc. **(Circle 538)**

Gearmaking

A rotary gear shaving machine is described and illustrated in a bulletin which discusses principal elements, operating principles, cutter head and table. Specifications and capacity tables are included as are close-up views of the tunnel type cast iron column and base design. National Broach & Machine Co. **(Circle 539)**

Heat-Treating

Bulletin covers full line of standard pre-engineered industrial furnace equipment for heat processing and includes a selection guide. Sunbeam Equipment Corp. **(Circle 540)** . . . Fluidized bed heat-treating equipment for annealing, normalizing, solutionizing, aging, hardening, quenching and isothermal transforming is described in a bulletin. Charts show comparative heating and quenching rates for steel. General Electric Co. **(Circle 541)** . . . A 4-page bulletin describes box furnaces without cooling chamber with ribbon or silicon carbide resistors for operation in heat-treating operations, tool rooms, laboratories and pilot operations. Also explained is when to use ribbon or silicon carbide resistors. General Electric Co. **(Circle 542)**

Inspection, Measurement

Applications and specifications of hardened stainless steel tooling balls used in making and checking jigs, fixtures and machine setups are covered in a bulletin. Industrial Tectonics, Inc. **(Circle 543)** . . . A catalog aids in the selection of hardness testing equipment and discusses several hardness tests. American Chain Cable Co. **(Circle 544)** . . . A bulletin describes and illustrates 12 types of inspection lights, conventional and rechargeable battery handles, and transformers to power these lights. It includes a separate listing of 15 types of miniature lamps with their electrical characteristics and dimensions. Welch Allyn, Inc. **(Circle 545)** . . . A 4-page catalog describes inspection machines such as automatic gear checkers and classifiers, gear rolling fixtures, gear speeders and a precision involute profile

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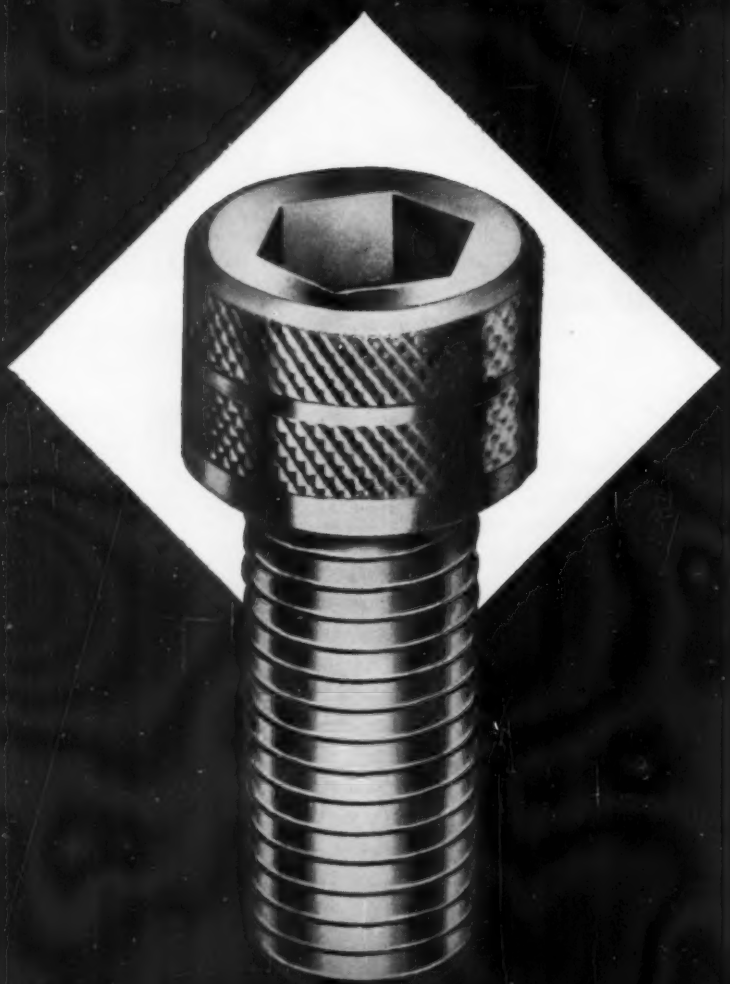

This DOUBLE-DIAMOND knurl marks the BRISTOL "Series '60"

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THE BRISTOL COMPANY Socket Screw Division Waterbury 20, Conn.

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Trade Literature

checking machine designed for checking gear shaving cutters. National Broach & Machine Co. **(Circle 546)**

Materials

Metal powders are designed for wide usage in a variety of industrial and experimental applications. They include stainless steel, commercially pure iron, silver, copper, aluminum-copper-nickel alloys and cobalt-chromium. Federal-Mogul Div. **(Circle 547)** . . . Data sheet covers hard surfacing austenitic manganese steel and discusses typical uses of manganese steel and the need for hard-surfacing. Wall Colmonoy Corp. **(Circle 548)** . . . Quick and ready reference to the comparative physical, mechanical and chemical properties of 17 high-temperature alloys is provided by a 20-page booklet. Haynes Stellite Co. **(Circle 549)** . . . Up-to-date physical data and characteristics of flame-plated coatings are covered in a series of bulletins. Linde Co. **(Circle 550)** . . . Six basic techniques used to mold products from pleasure boats to heat-resistant nose cones for missiles are explained in a booklet. Society of the Plastics Industry, Inc. **(Circle 551)** . . . Characteristics and typical applications of four grades of tool steels are contained in data sheets which also give instructions for forging, annealing, hardening and tempering, together with hardness data, elevated temperature properties and other information. Heppenstall Co. **(Circle 552)** . . . A spray gun for plaster, plastic and rubber is described and illustrated in a 4-page brochure. United States Gypsum Co. **(Circle 553)**

Milling

A chart suggests speeds, feeds and styles for high-speed end mills. Chicago-Latrobe. **(Circle 554)**

Pressworking

A bulletin gives complete specifications and has a number of action photos of coil handling equipment. Dixon Automatic Tool, Inc. **(Circle 555)** . . . A 20-page bulletin describes a line of open back inclinable presses in 16 to 75-ton capacities and discusses press construction, slide construction, inclining mechanisms and lubrication arrangements. There is also a detailed description of an air friction clutch and electrical controls. Minster Machine Co. **(Circle 556)** . . . Two electronic instruments designed to safeguard dies and presses during production runs are described and il-

lustrated in a product report. Niagara Machine & Tool Works. **(Circle 557)** . . . A line of mechanical or cylinder actuated in-line transfer equipment is described in an 8-page brochure. Livernois Engineering Co. **(Circle 558)**

Turning

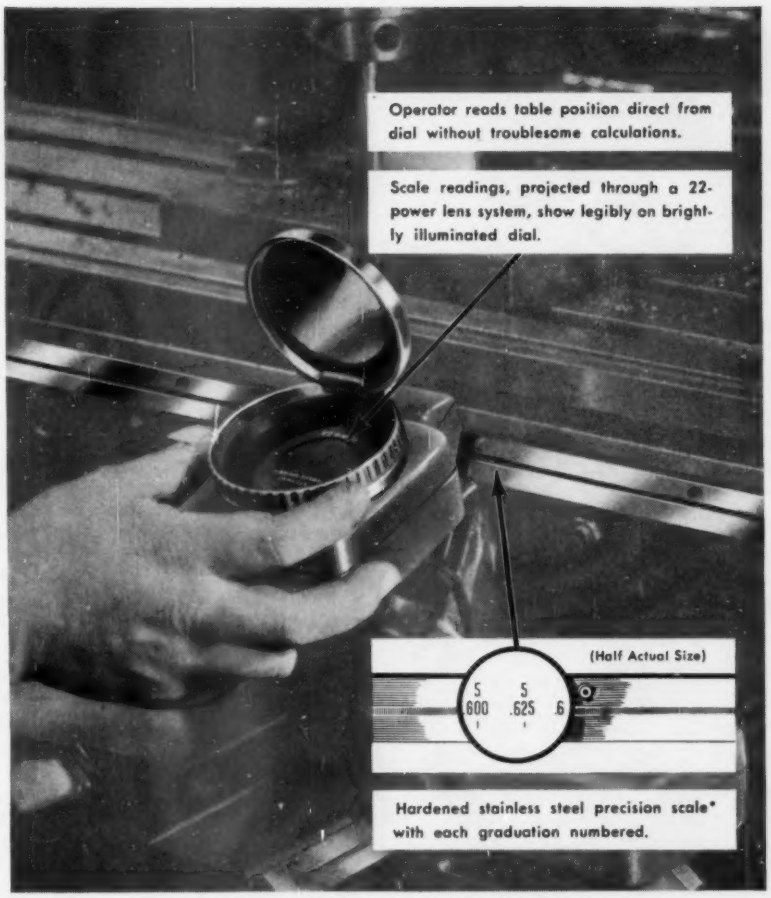
Line of seven heavy-duty lathes and vertical boring mills and the newest developments in single-point threading are described in a brochure. S & S Machinery. **(Circle 559)** . . . An illustrated catalog describes the capabilities of high-speed, automatic six and eight-spindle chucking machines and gives complete specifications. Baird Machine Co. **(Circle 560)**

Welding, Soldering

A line of production soldering irons for use on all electronic equipment, meters, and instruments is described and special irons and transformers for soldering printed circuits, transistors, and miniature and subminiature components for aircraft and missile assemblies are discussed in a bulletin. General Electric Co. **(Circle 561)** . . . A brochure entitled "Projection Welding Low-Carbon Steel with Embossed Projections" gives detailed information on projection welding techniques, projection forming tools, welding electrodes and joint design. Taylor Winfield Corp. **(Circle 562)** . . . An air-operated, press type, three-phase seam welder designed to cover a wide range of commercial and military welding applications is described in a bulletin. Sciaky Bros., Inc. **(Circle 563)** . . . Intricate metal parts can be reproduced from simple pencil sketches on ordinary paper with the automated flame-cutting machine described in an illustrated booklet. Linde Co. **(Circle 564)** . . . A bulletin describes operating features, construction details and application information on a trackless carriage for a semiautomatic squirt welder designed to make long welds. Lincoln Electric Co. **(Circle 565)** . . . A line of bench type spot welders in capacities from 5 to 50 KVA is covered in a bulletin. **(Circle 566)** . . . A group of leaflets cover the principles, methods and equipment used in aluminum soldering. Mondex Engineering & Sales **(Circle 567)**

Workholders, Fixtures

A bulletin on air-operated C clamps supplies description, specifications, outstanding features, optional features, ordering data and dimensions. Airmatic Valve, Inc. **(Circle 568)**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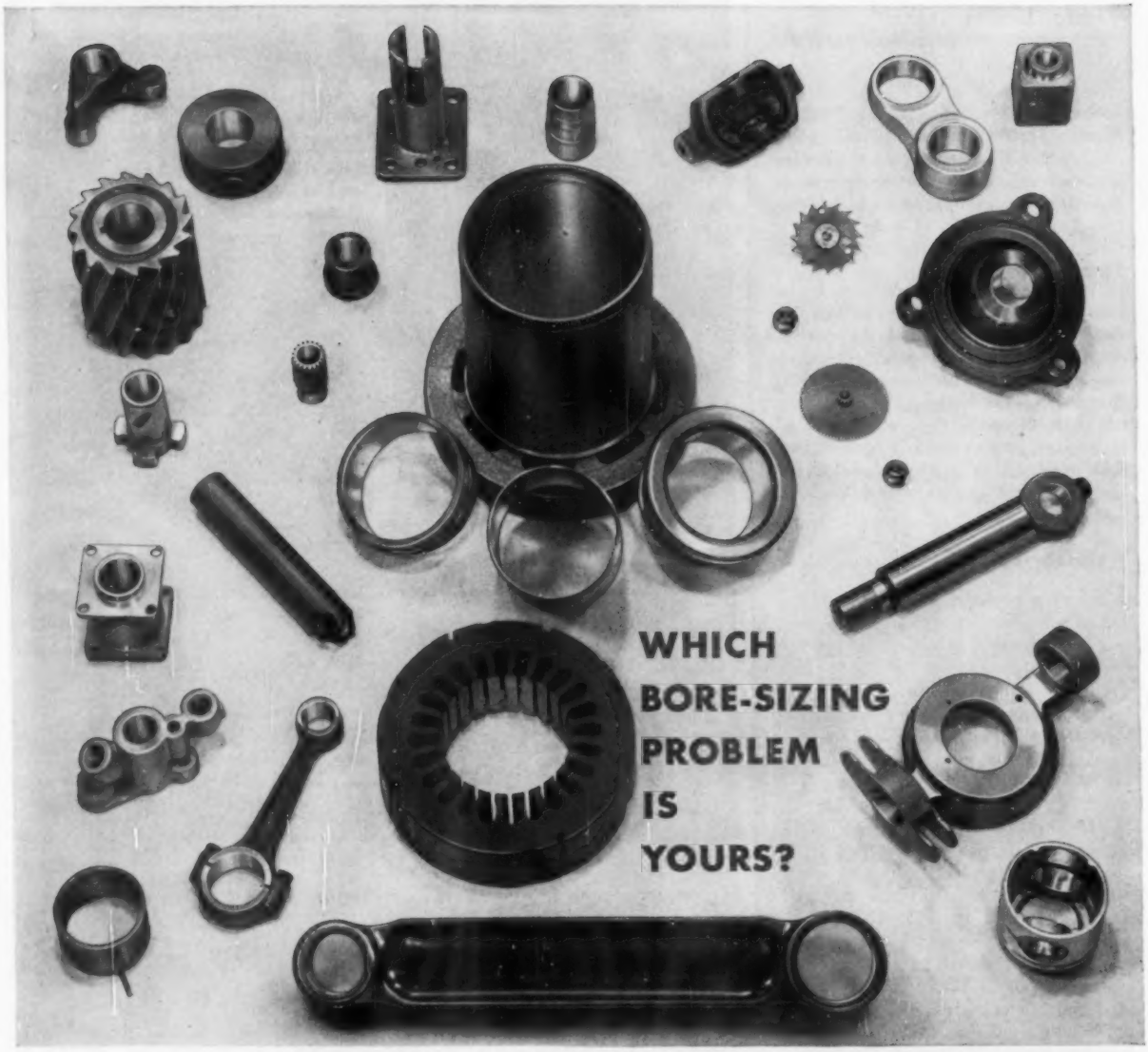

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TOOL ENGINEERING in Europe

By M. Kronenberg
Consulting Engineer
Cincinnati 6, Ohio

Applying Ceramic Tools

Successful operation of ceramic tools under heavy loads should not cloud the fact that these tools are brittle and that their reliability decreases with increasing severity of cutting conditions. Sometimes ceramic tools can make major cost savings possible, sometimes not. An article by F. Altenwerth in *Werkstatt und Betrieb*, Vol. 93 (7) 1960, p. 432, covers the problem of ceramic tool applications. The title is "Warum Schneidkeramik und wann erfolgt zweckmaessig ihr Einsatz?"

Altenwerth points out that improvements in tool materials are due to increases in heat resistance. The progress from high-speed steels to ceramics illustrates this trend. In the case of high-speed steel tools, it is usually mechanical wear, rather than high temperatures, that causes breakdowns. With the increase in cutting speeds possible with carbide and ceramic tools, temperatures at the cutting edge have attained greater significance. The softening temperature of carbides is around 2200 F and that of ceramics is about 3300 F. The annealing temperature for high-speed steels, on the other hand, is around 1100 F.

The author finds that there is a definite wear minimum that is attained with increasing cutting speed. This result agrees in principle with American findings. (See "Recent Developments in Ultrahigh-Speed Machining" by R. L. Vaughn and R. T. Krueck, THE TOOL ENGINEER, April 1960, p. 95.) He also states that the long life of ceramic tools at high temperatures is due to the slow reaction of ceramic oxides with the cast iron and steel work materials. This in turn reduces the area of contact of chip and tool, and reduces friction forces as well.

Altenwerth concludes that work materials having a high affinity with oxygen, such as aluminum and other light metals, have an adverse effect on ceramic tools. In addition, the low heat conductivity of ceramic tools makes them sensitive to rapid changes in temperature (such as occur when there are variations in the depth of cut) causing cracks and other failures. The author recommends always using ceramic cutting tips under compression and grinding them with diamond wheels only. The depth of cut should not be too small, because no true cutting action can exist at very shallow cuts. Also there is a minimum for tool wear, depending on the depth of cut.

When these rules are followed, ceramic tools can be used to advantage. Often an increase in tool life is associated with an increase in cutting speed. In his evaluation of shop practice, the author found that ceramic tools lasted three times longer than carbide tools when machining pearlitic cast iron. In another case, the life of ceramic tools was 250 pieces, as compared with 110 pieces for carbides. With ceramics a speed of 1320 fpm was used, as compared to the 390 fpm possible with carbides. Production time was 0.81 min per piece with ceramics; 2.87 min per piece with carbides.

Milling Power Requirements

Several years ago, R. Weilenmann published a method of calculating power requirements for milling operations. (See "Abstracts of Foreign Literature," THE TOOL ENGINEER, July 1957, p. 180.) Weilenmann has simplified the method, basing it on the concept of unit volume of metal removed, which depends only on the unit cutting force. His article appears in *Werkstatt und Betrieb*, July 1960, p. 451-2 under the title "Vereinfachte Berechnungen von Fraesleistungen."

The author has selected three examples which are rather simple to compute with the new method. Calculations by the new method occupy only one-half of a printed page, as compared to a full page for calculations by the old method. The same answer is obtained by either method.

Hydrostatic Drive

A hydrostatic drive has been installed in a vertical boring machine to find out whether such a drive can be successfully used in machine tools, according to an article by A. Whitworth in *New Scientist*, Vol. 8 (191), 1960, p. 151.

The application of hydrostatic transmissions to machine tools could have far-reaching effects. Gear drives, electrical equipment and so on would be eliminated. The machine described has a constant cutting speed feature so that the speed of cutting remains constant as the diameter of the workpiece is reduced. This results in improved surface finishes and reduced cutting time.

Russian Numerical Control

The programming of numerically controlled machine tools is beginning to play an important role in the Russian literature as witnessed by two recent articles in *Stanki i Instrument*, published in English in *Machines and Tooling*, Vol. 31, 1960, issues 2 and 6.

The title of the first article (by V. P. and N. P. Lapshin) is "Preparation of the Programming for Numerical Program Controlled Machines." The second article (by E. S. Kuzin) is entitled: "Preparing Information for Program Controlled Milling Machines."

The Lapshins discuss programming for the machining of three-dimensional workpieces with involved curved surfaces, with particular reference to milling operations. They divide programming into three parts: the machining process stage, the mathematical stage and the computing stage.

Two different methods for determining the tool-center path (in the machining process stage) are discussed. In one method, the intersection between the tool surface and workpiece surface is first plotted and the tool-center path is then offset from this. Three-dimensional calculation is generally required in this method. In the second method, an equation is found for the intersection of the tool and workpiece surface. This requires more mathematical work than the first method, but enables two-dimensional calculation of the offset tool-center path, even though the workpiece surface generated is three-dimensional.

Approximation of contours is also discussed by the authors, who cover techniques using chords, tangents and intersecting lines. (At the recent Machine Tool Exposition in Chicago, numerical control systems were demonstrated that did not require approximation, but produced the true contour directly.)

Cutting speed and feed formulas—and horsepower determinations as well—become more important with numerical control, although at present the formulas for conventional machining are still used. Tool wear can be taken into account in advance, thus increasing the accuracy of numerically controlled machine tools.

In the computing stage, the initial information is converted into the machine tool code and recorded on the tape. The authors recommend the use of automatic high-speed computers because experience has shown that preparation of programs without such computers requires several weeks of work when workpiece surfaces are complicated. They also discuss different types of interpolators, the advantages and disadvantages of magnetic tape in comparison with punched tape, and various other numerical control items.

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Two Russian computers, the "M-2" and the "Ural" are discussed. While the M-2 can perform 2000 operations per second and the Ural only 100, the total computation time required in one instance was 16.7 min for the M-2 as compared with 5.7 min for the Ural. This difference is due to the fact that the output time is considerably longer for the M-2 than for the Ural. The Lapshins recommend that the ratio of the speed of operation to the output speed, rather than the output speed itself, be considerable in determining efficiency. They call this quantity the "coefficient of relative output speed."

The Kuzin article is less general than the Lapshin article. It contains concrete formulas and mathematical derivations for milling operations by numerical control. Kuzin recommends dividing the preparation into several stages—calculation of individual points of the workpiece surface, cutting speed and feed calculations and, finally, the determination of consecutive milling cutter trajectories. In the second stage calculations are made for the intermediate milling cutter positions in consecutive instants and for recording the final decimal code. The author presents many formulas.

Symbols for Hydraulic Drives

A French-German standard for symbols to be used in hydraulic machine tools has been developed. It is described in an article by A. Schatz in *Werkstattstechnik*, Sept. 1960, p. 478. The title: "Oelhydraulische Sinnbilder zur Darstellung von Werkzeugmaschinen Getrieben."

These standards are based on the American suggestion to prepare hydraulic standards for industrial equipment, which was done as early as 1949 by the Joint Industry Conference. Corresponding symbols and standards were developed in England (British standard 2917/1957) and likewise in Germany, France and Russia. These standards are symbols of the functions of hydraulic drives in machine tools and not of design details.

It has thus been possible to limit the number of symbols. Hydraulic pumps, for example, can be represented by only three symbols—one for constant-delivery pumps, one for variable-delivery pumps and one for variable and reversible delivery pumps. It is unnecessary to include the type of design, such as gear pump, piston type pump and so on. Another advantage of the French-German standard is the elimination of words, letters and abbreviations. This makes it possible to use the standards on an international basis and even to include countries such as Russia, China, Japan and others.

The author compares the ways in which the old and new symbols can be used for a hydraulic broaching machine, a hydraulic drilling machine, a hydraulic tracer for a lathe and others. Several improvements are needed, in the author's opinion. He discusses the proposed improvements at length.

Tool Face Temperatures

Recent research has shown that the cratering of a tool face does not take place in the shape of a uniformly deep groove but that it is deeper towards the cutting edge. This is discussed by A. M. Sadek in *Maschinenmarkt* for October 7, 1960, p. 33, in an article entitled: "Kolkbildung und Temperatur Verteilung auf der Spanflaeche von Drehmeisseln."

The nonuniform crater formation is due to the distribution of the temperature on the tool face. The author rejects some of the physical laws that have been established with regard to stress distribution. In addition to tests, the author has also calculated the temperature distribution in three dimensions, disregarding, however, convection and radiation of heat. He assumed a plane heat source extending over the tool face and determined the lines of equal temperatures, which agreed very well in their distribution with the lines of equal crater depth.

Grinding Wheel Unbalance

A paper presented by H. Kalizer-Netherland before the Machine Tool Congress held in Germany is abstracted in *Werkstattstechnik*, No. 10, 1960, p. 562. He reported on the vibration caused by unbalanced wheels. He came to the same conclusion as Rotzoll, Popov, Puzanov and Landberg. Grinding machines that are solidly fastened to the floor exhibit larger amplitudes between wheel and work than machines that are floating on the floor.

Digital Programming

An article dealing with the development of digital programming of machine tools in Germany appears in *Werkstattstechnik*, Vol. 50, No. 9, 1960, p. 496. The article, by W. De-Beauclair, is titled: "Das Lochen und Lesen von digitalen Programmen zur Werkzeugmaschinen Steuerung."

After discussing the differences between analog and digital controls, the author describes (in detail) tape punching and tape reading instruments, punched cards, code systems and magnetic tape. He recommends that punched tape be standardized. (This has been substantially accomplished in the United States, where 1-inch, 8-channel tape is standard.) In addition to German controls, others are discussed.

who's meeting and where

Jan. 9-11. Seventh national symposium on reliability and control. Sponsored by the American Society for Quality Control, Institute of Radio Engineers, Inc., American Institute of Electrical Engineers and Electronic Industries Assn. Bellevue-Strafford Hotel, Philadelphia.

Jan. 9-13. SOCIETY OF AUTOMOTIVE ENGINEERS. International congress and exposition of automotive engineering. Discussions on ground and flight vehicles of today and tomorrow. Cobo Hall, Detroit, Mich.

Jan. 11-12. AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Seminar entitled "Quality Control for Improved Production." Chase-Park Plaza Hotel, St. Louis, Mo.

Jan. 17-19. AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Seminar entitled "Machining and Forming Space Age Metals." Statler Hilton Hotel, Dallas, Texas.

Jan. 19-21. AMERICAN SOCIETY FOR ENGINEERING EDUCATION. Conference on engineering graphics. Wichita, Ka.

Jan. 23-26. Plant maintenance and engineering conference and show. Emphasis on managerial and technical aspects of maintenance. International Amphitheatre, Chicago, Ill.

Jan. 23-27. Curtiss-Wright Princeton Division. Course in ultrasonic inspection techniques. Emphasis will be given to the inspection of welds, pipe and tubing, and to new recording techniques. Curtiss-Wright Corp., Princeton, N. J.

Jan. 23-Feb. 1. University of California Los Angeles Extension. Course in engineering and management. Extension Campus, Los Angeles, Calif.

Jan. 24-27. SOCIETY OF PLASTICS ENGINEERS. 17th annual technical conference. Shoreham Hotel, Washington, D. C.

Jan. 24-28. NATIONAL TOOL, DIE & PRECISION MACHINING ASSN. Winter board meeting, Biltmore Hotel, Palm Beach, Fla.

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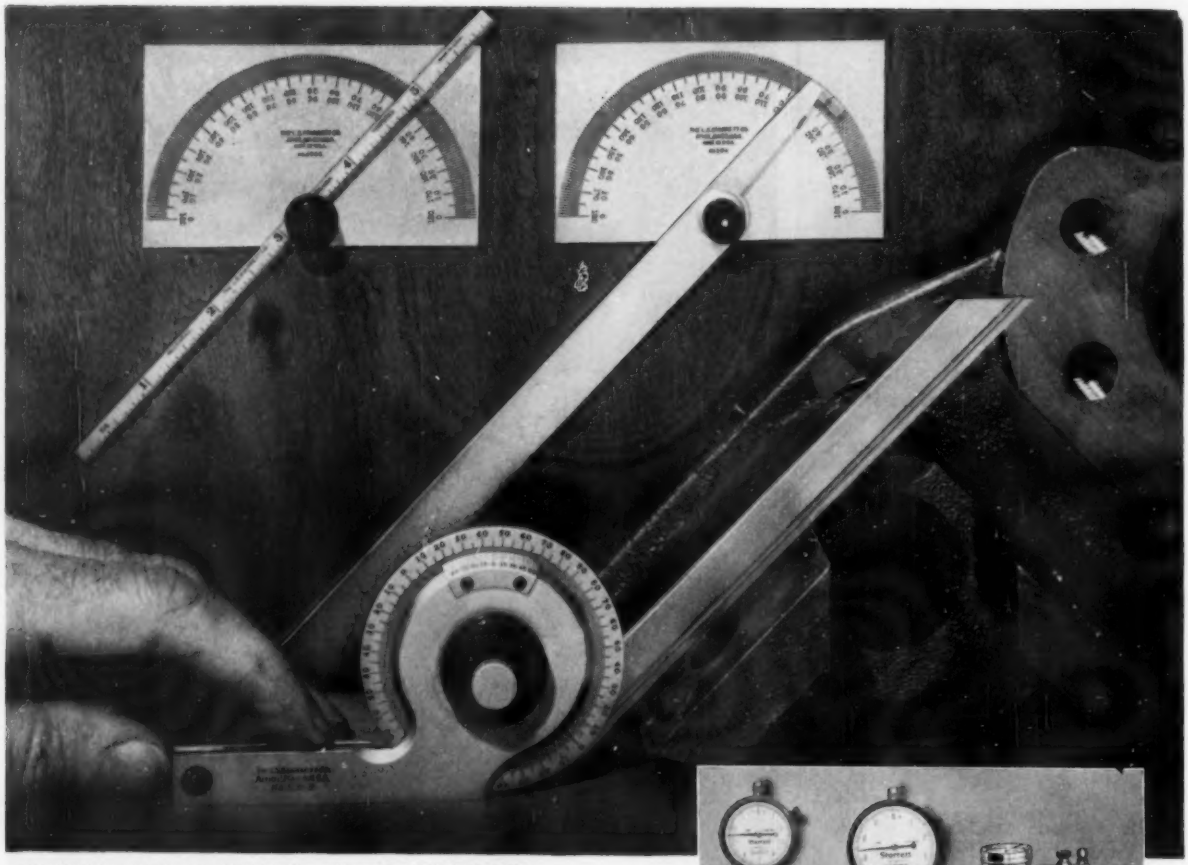

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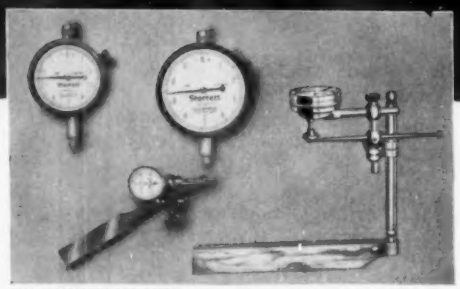

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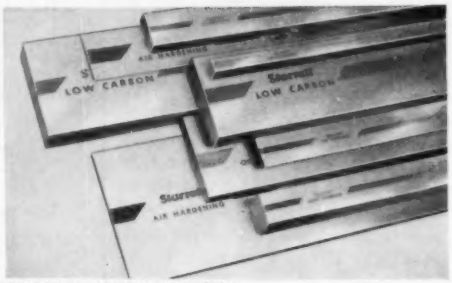

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Tech Digests

Design and Use of APT LANGUAGE

APT IS AN ABBREVIATION of "Automatically Programmed Tools." The system was developed at M.I.T., sponsored by the Air Material Command, United States Air Force. Automatic programming is a new technique made possible by modern computers in which the instructions are not given in detailed numerical form, but in terms of "English-like language" convenient for people to use. Automatic programming also permits all the difficult mathematical computations associated with the use of numerical control to be performed automatically by the computer so that the job of the human part programmer is greatly simplified.

If a language is to be successful, it must offer a good match to the natural behavior patterns of both the sender and the receiver. In general this is accomplished by operating the communication link in three principal segments. The first segment is a language form particularly adapted to the sender; the third or last segment is a language form particularly adapted to the receiver; and the middle segment is the translation procedure going from one language form to the other. From the point of view of designing languages, it is necessary to consider the over-all package of two languages and the translations as one over-all system. The final complete language package is strongly influenced by the characteristics of the sender and of the receiver and by the translation scheme.

The physical representation of the language is of considerably less importance than the selection of the vocabulary and the syntactical construction of the language itself. In the case of the APT system, the language link of primary interest is that going from the human part programmer (the sender) to the computer (the receiver). Thus, one of the main problems is to design a language for explicit geometric and machining instructions that is convenient for the part programmer to use, and which can be economically translated to terms that the computer can understand.

What kind of person is the average part programmer? What kind of training has he had? What does he think about machine parts? These questions are important from the point of view of language design, since the structure and format of the language must fit naturally into the framework of the part programmers' past experience and knowledge. To a great extent, these patterns have been influenced and primarily determined by the old methods for producing parts. The language form desired is not one that will mirror exactly the existing techniques and processes, but rather one which takes advantage of the capabilities of numerical control and automatic programming to increase the part programmers' capabilities. A properly designed language can advance capabilities of the production process without requiring large expenditures of money and effort.

The Geometric Language: How is a part described? Most parts are composed of a multitude of subparts, each described by a single mathematical expression, so that the major consideration of the language must be a description of how these subparts are interrelated to constitute a whole. This is the human's point of view. The machine considers the same parts to consist of thousands of tool center locations connected by straight lines. The information contained in the two viewpoints is essentially the same, but the human's view consists of much fewer units of much greater information density than the machine tool's.

How are the subparts to be described? We prefer their natural descriptive names rather than complicated mathematical expressions. In order to tie all the subparts together into a single total part, one basic frame of reference must be chosen. Then each separate part can be expressed in terms of that coordinate system. But, how natural is it to describe the subpart in the selected coordinate system? The simplest mathematical expression for a circle is to select the proper coordinate system and then write $X^2 + Y^2 = R^2$. But that same circle in fact may be more conveniently described by saying that it is tangent to two lines, with a specified radius, or that it passes through three points. Thus, the realization that such a distinction can be made between specifying the equation for a subpart and describing the subpart, opens a new area for language design.

In general, a part has only certain critical dimensions and subparts which must be precisely located and specified. The remainder is in fact only connective tissue. If we look over the shoulder of the designer, he will specify that a bearing plate of specified size must go in one place and a strut or support must go in another place. On the basis of these critical components, he fills in the remainder to satisfy less important requirements. When the design reaches the part programmer, he must follow what the designer has specified. The most natural way to describe many components is by their relationship to other components, because this is the way the designer determined them in the first place.

The description of geometric components in terms of their relationship to other components calls for the use of names and descriptive modifiers. Rather than require full description of the components, it is easier to give names to basic components and to specify what kind of relationship one component has to another. It would be possible to use a unique descriptive word for each single case to be encountered. But the decision is made to separate multiple cases through the use of compounded statements made up of descriptive relationship words and modifiers. This means that statements will be somewhat longer than

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necessary, but the vocabulary of the language can be made small. Relatively few modifiers, carefully chosen, can distinguish and describe a large number of cases. As long as the ideas represented by the words are natural for the programmer to use, the language is easy to learn and apply.

A striking advantage of this method is the minimization of numerical data. When full advantage is taken of the ability to define components in terms of other components, most numerical parameters required to define the mathematical form of a geometric component are implicitly determined. This is appropriate to the part programmer, since he is experienced in tooling, production, and metalcutting, but extensive mathematical calculations would be foreign to his background and make the language difficult. Another implication of the language form is that it can be used for calculating, resulting in considerable savings

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in cost and effort. Nonreal components can be introduced to solve for unknown dimensions. For example, almost all drafting operations are performed using straight lines and circles, sometimes in very elaborate and precise ways to determine dimensions. With APT it is possible to perform all these operations by statements made in the language. The final implication of the geometric language is that it accommodates design changes readily. When a part is described by the relationship of its subparts, drastic changes can be made in the basic components without destroying the integrity of the part. In such a case, all the intermediate subparts that serve as connective tissue will automatically change and distort to accommodate the new information.

The language of the type described does not merely save a little drudgery for a few individuals, in actual fact it represents a sizable step forward toward an improved technology for the production of complex parts.

Tool Motion Language: The part programmer must be able to exercise control over the machine tool. Specification of the size and shape of the cutting tool as well as control of on-off

functions is carried out in terms of natural descriptive words. Control of motion introduces a language-design problem distinct from that of the geometric language. In the geometric description, the vantage point from which the part is described is primarily the chosen coordinate system for the part. This vantage point is appropriate for the static description of the geometry, but is not well-suited to the dynamic description of tool motion. To coordinate tool motion with geometric description, the basic frame of reference is retained. But in general, only the initial tool position and initial tool direction are given in terms of the coordinate system itself. All remaining tool motions are specified by descriptive terms relating the tool path to the geometric description of the part.

Many ways exist to describe curvilinear motion of a cutting tool in three-dimensional space. The most natural way to think of tool motion is in terms of curves drawn on the surface of the part. One slight complication arises due to the fact that the cutting tool is not a point but a geometric surface of revolution. Thus a new surface called the driving surface is introduced to complete description of the curve. The part programmer adapts the vantage point of riding along the tool as it progresses around the part. Motion along the curve determined by a part surface and driving surface pair is terminated by encountering the driving surface-part surface pair for the next subpath. Since the vantage point for considering tool motion is the tool itself, the most natural designators for the proper branch to follow at an intersection are terms such as GO RIGHT, GO LEFT, GO UP. Additional terms for starting cuts and handling special situations such as GO TO and GO PAST are introduced to describe the desired relationship. In this way a language is built up that is fully accurate for describing desired tool motion in terms of the same geometric surface components used to describe the part. By using modifiers such as DONT CUT, sequences can be built that move the tool along pseudo-surfaces (the tool doesn't actually move) to place the tool at some desired point without having to do the actual calculation.

Written Language: APT is so constructed that there are only a few basic rules that must be learned concerning placement of words in the statement structure. If a statement makes proper English sense it will match the rules of the language. This means that the only training necessary to learn the language is to learn the appropriate viewpoint for the geometric and tool-motion aspect of the language, learn the meanings of the individual words, and learn whether they go in the major or minor portion of a statement. The only major requirement in addition to learning the basic vocabulary is to "use" the kind of statements that are grammatically correct.

Future Improvements: Extensions in the language will be brought about by the completion of an APT III capability for programming by regions rather than by curves. Tool motion instructions will be modified to permit specifying spiral or zigzag machining of regions. A macro-instruction facility is also under development. This technique permits collections of APT language statements to be grouped together and given a name. Associated with the name are any critical parameters used in the statements that are to be treated as variables. Once a macro-instruction has been defined the part programmer need merely give the name and specify what settings are for the critical parameters and the system will automatically set up the entire

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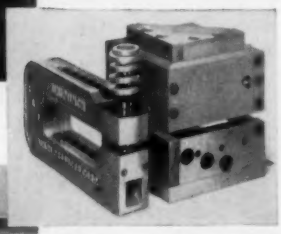

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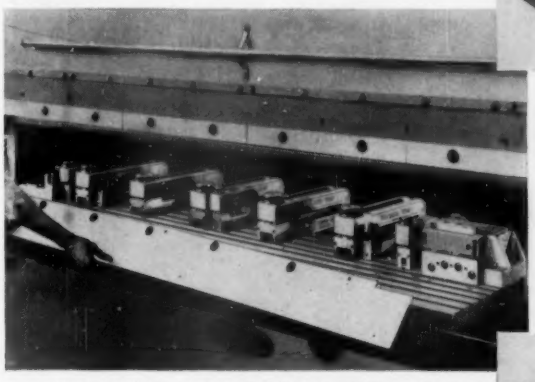

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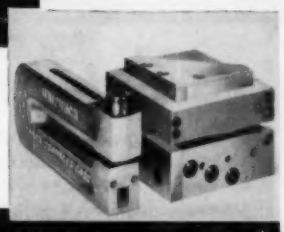

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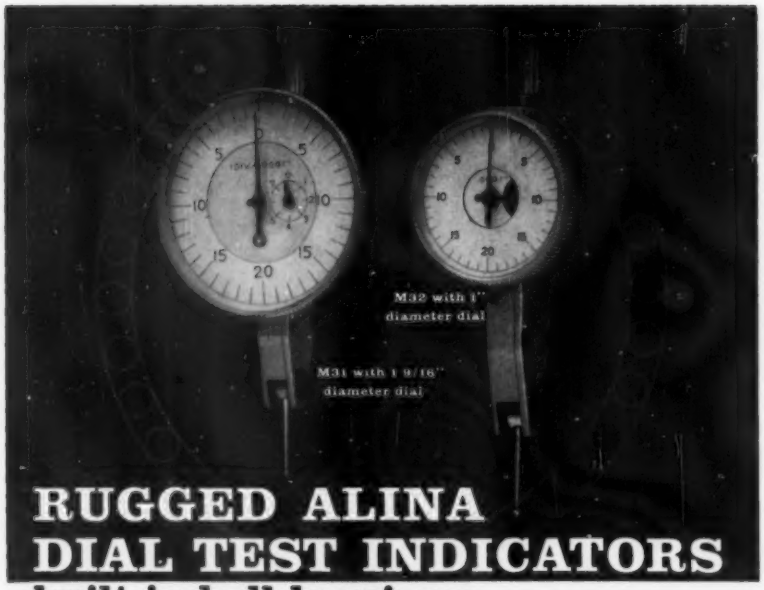

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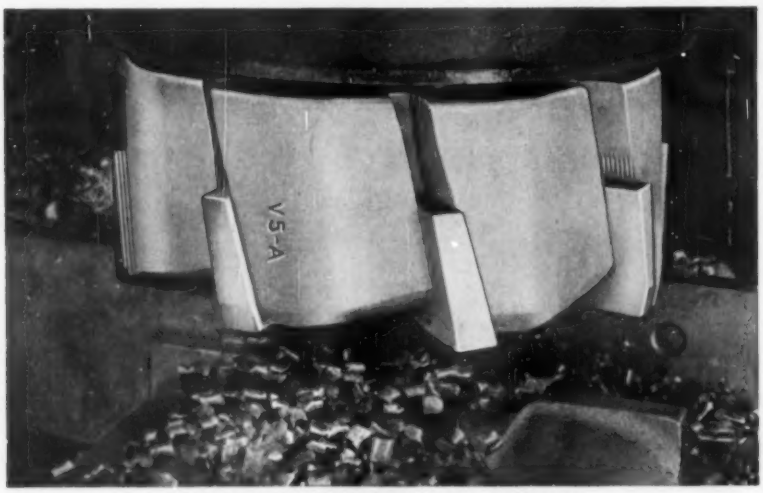

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tech digests

collection of statements. For example, part program segments representing intricate instructions with ruler and compass can be programmed once and for all and established as a macro-instruction. Another development currently being pursued is the introduction of logical and jump instruction. This will allow the APT system to make decisions and modify its behavior. For example, it would be possible to state that a set of APT instructions should be obeyed until the tool comes into the vicinity of some particular surface. When this happens a new set of instructions is to be obeyed. A final feature to be expanded in the future is the provision for increased control over functioning of the APT system. This will permit the part programmer to interrogate the system, asking for an accurate report on conditions which would be useful in evaluating the adequacy of a given program.

In addition to figuring printed output about the program, this control will also drive the three-dimensional part-perspective program so that the programmer can have a picture of what is happening. This will permit him to accomplish detailed checking of part programs in a convenient and reliable fashion without consuming actual machining time.

From the "The Design and Use of the APT Language for Automatic Programming of Numerically Controlled Machine Tools" by Douglas T. Ross, Massachusetts Institute of Technology, presented at the 1959 Computer Application Symposium, Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill.

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error detection and retransmission is often used and requires much less equipment.

Channel capacities for data transmission facilities generally is selected according to traffic needs. Data can be transmitted at a rate of over one million bits per second over ordinary telephone cable. For example, a PCM (pulse code modulation) can carry 24 simultaneous voice conversations. The PCM system transmits digitized voice. The incoming voice is sampled at a rate of 8000 times per second. Amplitude of each sample is encoded to seven bits, and an eighth bit is added for timing. As a result, 8000 eight-bit samples per second or 64,000 bits per second are used to represent a human voice. Twenty-four channels combined on a single cable pair thus transmit at 1,544,000 bits per second. This rate exceeds the combined output of 20,000 teletypists simultaneously operating at top speed.

The bell system describes the use of the telephone network for data communication by the word "Data-Phone." The Data-Phone set is analogous to a telephone set in that it couples a machines to the telephone line. The business machine industry has developed remote input-output devices, punched cards, magnetic tape and paper tape

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data transmission terminal equipment to use the Data-Phone service. Recently developed are RCA's DASPAN, Friden's Teledata, IBM's 1001 and 1009 and arrangements by Digitronics, AVCO, Teleregister and others.

Most communication systems include three fundamental components; channels, terminal units and switching. Channels and terminal units have been briefly described. Switching is required to associate each point of activity with any other required point. Several approaches are being used to switch data: (1) selective signaling; (2) message switching (store and forward); (3) circuit or line switching. In selective signaling, all systems are permanently connected to a single channel and a controller lets first one station transmit, the next, then the next, and so forth. In message switching systems, each data message is transmitted to a

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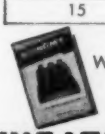

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switching center at which it is stored until a channel becomes available. In line switching systems, an address is sent in advance of the data message. This is like making a dialed telephone call. The "address" is the telephone number sent in advance of the message.

Using leased or private lines, or direct distance dialing, a machine can originate a telephone call. A computer would generate a message to be delivered to a remotely located machine. The computer would indicate to a Data-Phone set that it wished to make a call. When the Data-Phone indicated the equivalent of dial tone to the computer, the computer would then spill forward the telephone number (the address) of the called station. At the remote location, the Data-Phone set would—instead of ringing a bell—indicate to the remote business machine that it was being called. The called machine would then receive the message and proceed to talk with the remote machine, or an input-output device.

Those working in the electronic data communications field feel that we have just begun to develop the potential of facilities already at our disposal. Engineers and designers are just beginning to grasp the variety and scope of data traffic requirements, and to understand input-output devices best suited to matching man to machine, and vice versa. This will lead to a wide spread usage of electronic data communications to supplant the physical shuffling of papers and physical transport of data.

From "Data Communication Between Remote Machines," by V. N. Vaughan, Jr., American Telephone and Telegraph Co., New York, N. Y. Presented before The Computer Applications Symposium, October 26, 1960. Sponsored by the Armour Research Foundation of Illinois Institute of Technology.

▼ ▼ ▼

Inventions for Profit

Some inventors are good at developing ideas for making things cheaper, other inventors specialize mainly in doing things never done before, such as Boss Kettering. In either case, profits are probably the biggest stimulation for inventors. In the United States, the tax office and patent office now recognize this fact, and are allowing inventors to get capital gain from inventions instead of straight income as before. This is a great incentive. In Russia, the need for invention and for incentive have been recognized. Since it is uncommunistic to keep the patent as personal property, Author Certificates are issued. The individual who invents something receives an award, and interestingly, his supervisor shares 25 percent in the award and the factory manager gets another 10 percent. This eliminates the opposition of management to invention. Author's Certificates are being issued at the rate of about 15,000 per year.

Some examples from the experience of the Rand Development Corp.—a corporation for profit—in inventing for profit are probably pertinent. We became interested in using fiber glass as a corrosion-free structural light-weight material. It had been previously tedious to produce. The problem involved was a manufacturing problem. It appeared to be impossible to keep hardened-steel cutters sharp for producing the continuous strands of glass needed. Finally, one of our physicists realized that you can't cut glass, it will dull anything. But glass is brittle and it can be broken. So instead of having the hardened tool steel cutter against a hard-steel roller, he used a razor blade and a rubber roll to bend the glass and it broke.

This invention did something cheaper and better. It went back to the original material and cut perhaps 75 percent

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of the labor cost, so it couldn't help but make money.

A doctor informed me that many cancer patients must have their vocal chords removed and it takes a long time before they learn how to speak. We devised a small signal generator and amplifier with speaker, transistorized it and found that when we put it in the mouth, words could be formed by moving the lips and tongue. I took it to a cancer congress in Miami and gave it to a bartender who was taking orders by writing on a slate because he couldn't talk. He demonstrated it before the cancer congress, appeared on TV, and was written up by newspapers. By the time I returned to Cleveland, there were orders for about 1000.

Other developments that underwent a similar course are a "bug-proof" environment. We developed this for people in intelligence work, who do not want to have their conversations monitored by hidden microphones. One of our retired engineers who likes iced tea but was unable to store it found that by putting in a clarifying agent to keep tannin from precipitating and settling, the tea could be bottled and kept indefinitely. In our work on cancer, we found that methods used for isolating polio virusus could be applied to cancer. We have isolated a nucleic acid from human leukemia and human cancer and are growing it in human tissue culture. We will probably obtain basic patents on the isolation of viruses from human sources. And it looks hopeful that we will have a protective agent within the next few years.

From our experience, the major problem in inventing for profit is knowing when to quit. The biggest problem is to avoid staying too long on something which is too far in the future. With the exception of the cancer project, we feel that most developments should be demonstrable in six months and ready for prototype manufacture in a year.

From "Inventing for Profit" by H J Rand, President, Rand Development Corp Presented before the Cleveland Engineering Society, 3100 Chester Ave, Cleveland 14, Ohio.

Leaded and Nonleaded Steel Properties

Since most service failures are the result of metal fatigue, the fatigue strength, otherwise known as the endurance limit of leaded grades of steel, is important to manufacturing engineers. Impact properties of steel are important in applications such as gears which require that the part shall absorb without failure a definite amount of impact energy. Little quantitative data have been published to date regarding the fatigue strengths and impart properties of leaded alloy steels at high-strength levels.

As Westinghouse uses a considerable amount of SAE 4140 steel at high-strength levels for gears and pinions, the substitution of a free-machining leaded alloy steel is desirable from an economic viewpoint. The application is stringent however, and an investigation was instigated to determine the practicallity of substituting leaded free-machining SAE 4140 steel for conventional grades.

The investigation consisted of: (1) fatigue testing leaded and nonleaded SAE 4140 steel at 55 and 47 R_C hardness levels; (2) charpy V-notch impact testing leaded and nonleaded steel at a hardness level of 47 R_C at various temperatures; (3) tensile tests of leaded and nonleaded specimens at 55 and 47 R_C.

The investigation yielded the following conclusions: (1) differences in transverse (to rolling direction) fatigue, impact and tensile properties between leaded and nonleaded SAE 4140 at 55 and 47 R_C are insignificant for normal applications; (2) transverse fatigue, impact and tensile strength of leaded and nonleaded SAE 4140 are lower than the corresponding longitudinal properties. Both the leaded and nonleaded SAE 4140 steels at 55 R_C had all of its strength at about 270,000 psi when tensile tested longitudinally, but only about 170,000 psi when tested transversally; (3) the low transverse properties are caused by inclusions commonly found in commercial grades of SAE 4140. These inclusions act as stress-raiser notches and have their major effect in the transverse direction.

As a result of these conclusions, the following recommendations can be made: (1) all design calculations for transversally loaded pinions and gears should be made on the basis of transverse properties; (2) a grade of steel less notch sensitive than SAE 4140 or a cleaner grade such as vacuum-melted SAE 4140 should be used for gear and pinion applications that are heavily leaded transversally. It has been reported that the vacuum remelting of an SAE 4340 steel resulted in an im-

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provement in the ratio of transverse and longitudinal fatigue strength, from an original value of 61 percent to 81 percent at 41 R_C.

From "Fatigue, Impact, and Tensile Properties of High Strength Leaded and Nonleaded SAE 4140 Steel," by William Simon, Westinghouse Electric Co. Presented at SAE National Farm, Construction and Industrial Machinery Meeting, Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

Creative Thinking

Creativity seems to be more essential today than at any time previous in our history. Historians assign various reasons for civilizations' decay, but the evidences are that there is a decline in creative thinking. This is possibly the best explanation for the current decline in productivity per manhour per cost of dollar of reducable assets. That is, since 1940 we have doubled our engineering force, and research dollars have increased—to 650,000 engineers and $12,000,000 a year respectively. And during the same time, manufacturing of productivity per manhour has increased 40 percent. But in the over-all view including investment, our productivity is declining. Total spending nearly doubled, but the average rate of return on manufacturing decreased more than a third from its postwar high.

Considering the types of thought in the accompanying table, it would appear that our ancestors were more creative than we. It appears that creativity

Types of Thought

Characteristic	Method	Subject
Creative Nonlogical, long-term	Mystical	Ideals, primordial religious impulse
Big gain Dominates physical activity	Originating Discovering	Poetry, art Scientific principles
Noncreative Logical	Devising	Technology, business politics
Short-term Small gain Dominated by physical activity	Animal cunning	Predatory destruction

is inherent in man, but that since the era of civilized man, creative powers are not being used effectively. Recent experience indeed seems to reinforce this impression.

How can we recoup the ability to think more creatively? First, there is the technique of asking "certain peremptory questions" to rethink a concept creatively for a better one. For the modern civilization-conditioned individual, how to think creatively resolves itself into three activities: (1) think; (2) read or acquire knowledge; and (3) write or express in some way what the thinking produces. The three-pronged activity should take place in areas strange to the individual's mind. For increasing creativity of groups, again three major paths are offered: (1) basic intellectual disciplines are important to creativity. Experience indicates that the greatest creations come from combining widely separated elements which the usefully educated mind would consider the least likely to be related. Thus, education in widely separated fields of knowledge is important to creativity. (2) Use of the mind is essential, and this appears to be an "awareness" probably more intense in the creative individual than in the noncreative individual. (3) In sponsored creative efforts, it appears that more achievement results from sponsorship of men than from that of projects.

Previous experience with this approach, used in 1957 with a group of over 100 engineers indicates that creativity can be stimulated. One engineer's contribution of patent memoranda rose from 1 in 1957 to 19 in 1958 as a result of his deliberate efforts at increasing creativity, using these methods.

From "How: The Riddle of Creative Thinking" by Mercer H Parks, Humble Oil & Refining Co., presented at The Cleveland Engineering Society, 3100 Chester Ave., Cleveland 14, Ohio.

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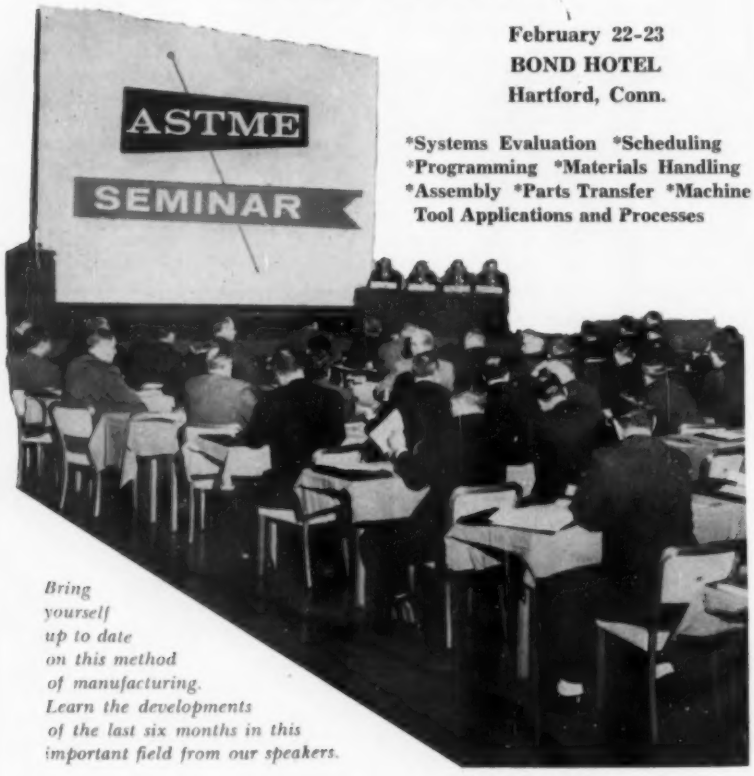

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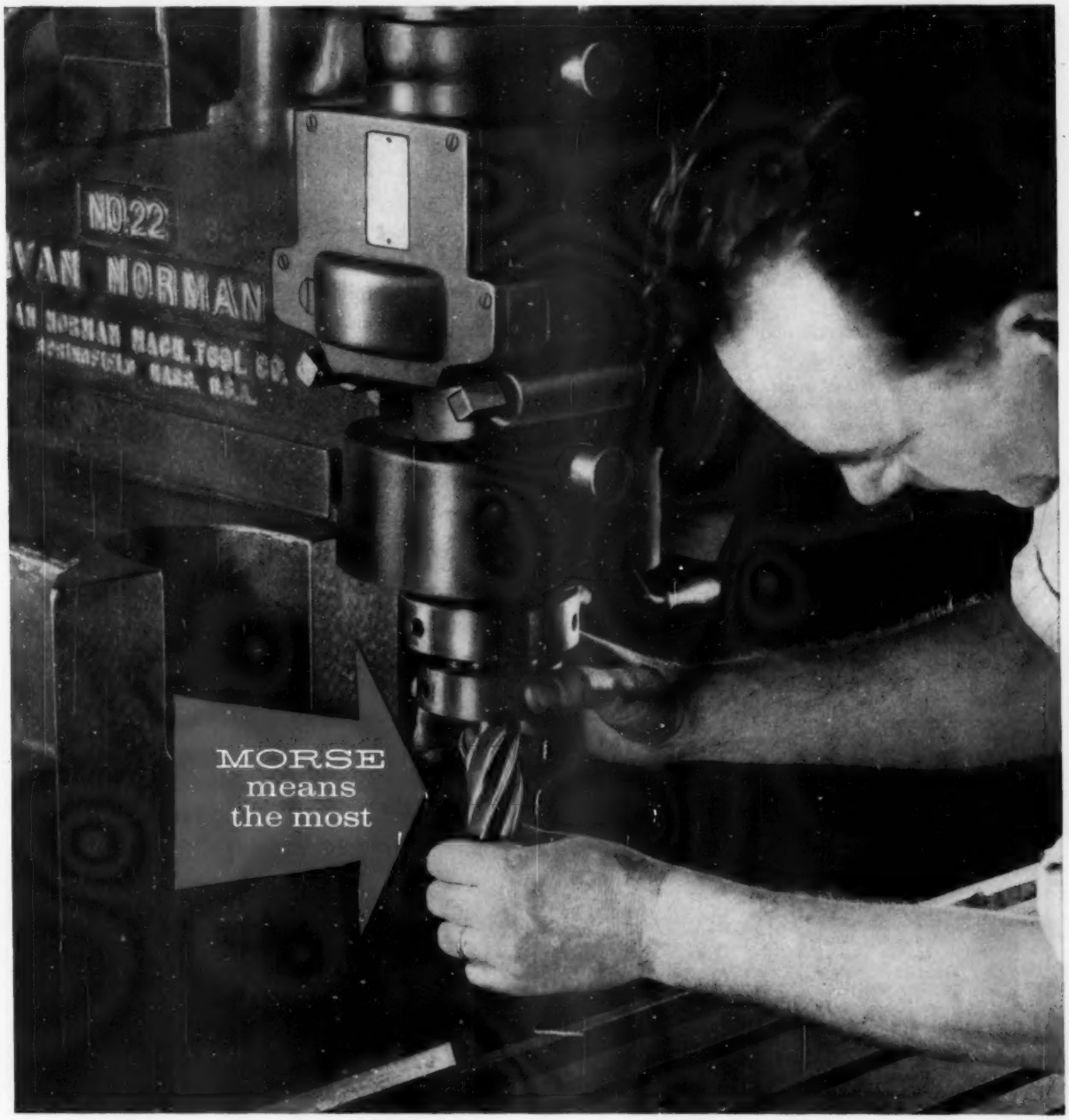

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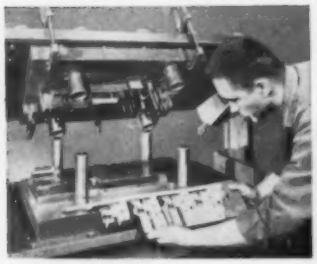

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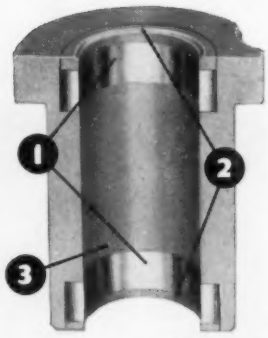

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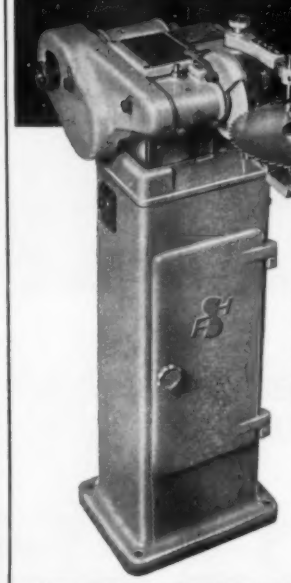

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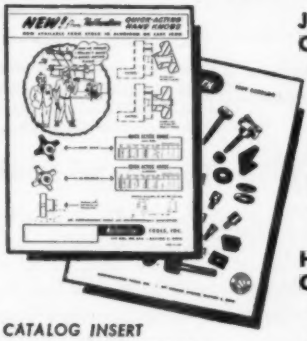

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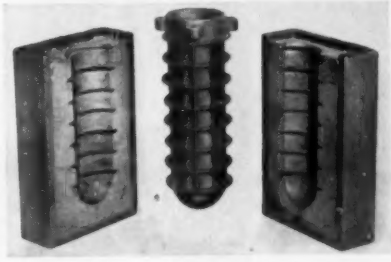

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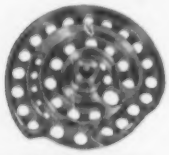

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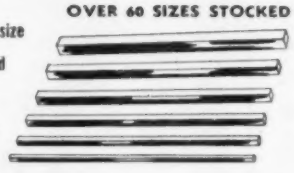

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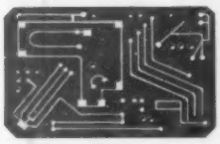

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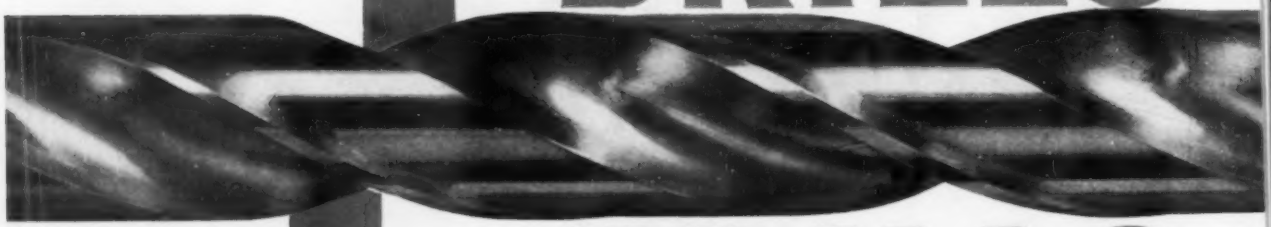

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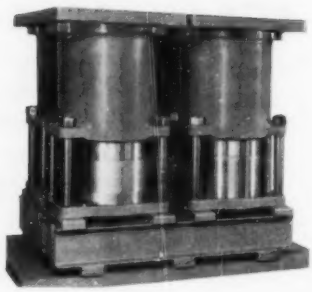

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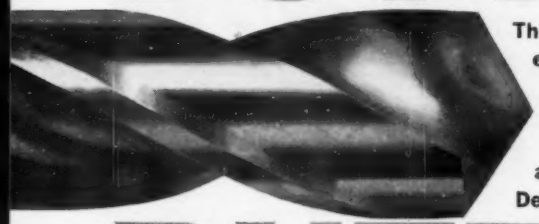

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Mayline metal plan files have hinged dust covers that stay in upright position when drawings are being removed or inserted in drawer—leaves both hands free. Drawers operate freely on muted ball bearing rollers.

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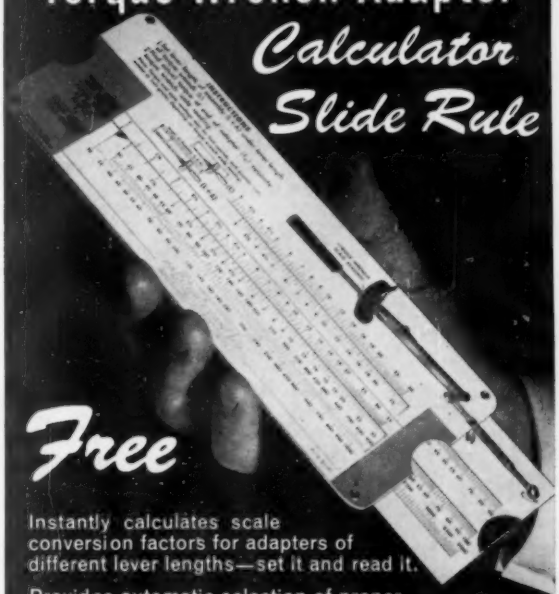
Torque Wrench Adapter *Calculator Slide Rule*



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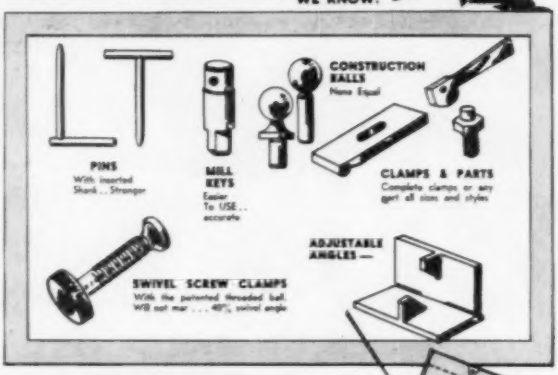
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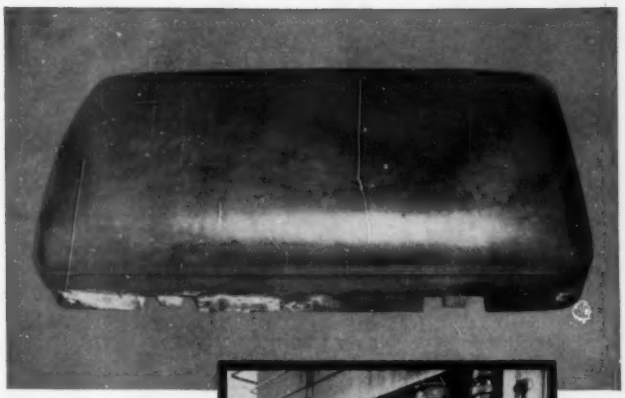
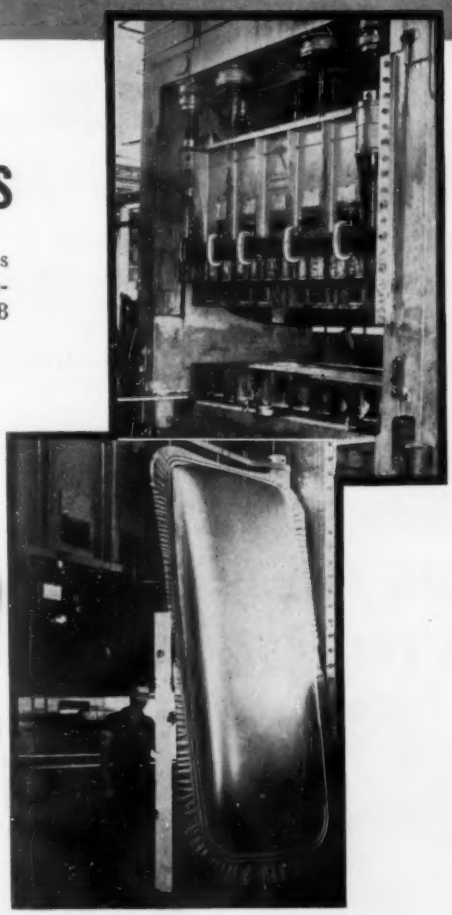
THIS PUNCH FACED WITH REN EPOXY RESINS

Built by Allied Products Corporation for stamping ambulance roofs, this punch is constructed of a zinc alloy core, faced with a 3/8" thickness of epoxy resin compound. The use of epoxy facing shortened tooling time—simplified the program—and reduced labor costs for an overall savings of 50%!



ON THIS TOGGLE PRESS

The punch is held in place by five large clamps on each side of this 13-ton toggle press. Stampings are drawn from 80" x 164" sheets of 18 gauge steel.



STAMPS THIS ROOF!

The roof stamping measures 68" wide, 158" long and 8" deep. Allied Products uses this epoxy tooling process to stamp approximately 4,000 roofs annually for the Miller-Meteor Company, Belfontaine, Ohio.

Reduce tooling costs at the start of the program—by selecting Ren epoxy resins for the tooling process. Engineers report programs simplified by **40%***—time saved to* **70%** *—and overall tooling costs reduced by* **50%**! *Dependable epoxy formulations by Ren provide lasting dimensional stability, rugged compressive strength — plus scheduling flexibility that permits easier, quicker design modifications.*

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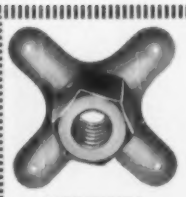

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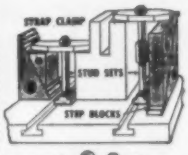

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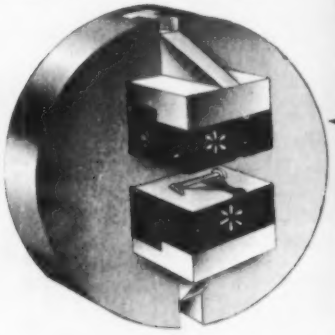

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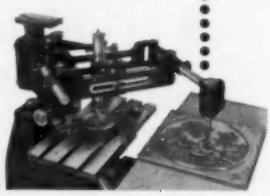

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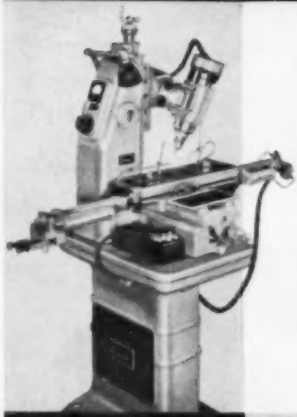

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With the A-L Steelector System

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It's easy to make accurate selections with the STEELECTOR Program. The three STEELECTOR cards—covering general purpose tool steel applications, hot work applications, and high speed grades—show at a glance the comparative properties of tool steel grades that will suit 96% of all tool steel applications listed in the A-L Tool Steel Handbook.

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For each grade, there is a Data Stock List that tells you the exact analysis of the grade, its basic properties, typical applications and their working hardnesses, and temperatures for hardening, tempering, and annealing. And the complete range of available sizes and shapes is listed.

You can count on getting quality tool steel by using the STEELECTOR Program. Each STEELECTOR grade has been selected from the complete line of Allegheny Ludlum Tool Steel and made under the exacting quality control standards of all A-L products.

The new A-L Tool Steel STEELECTOR booklet contains the STEELECTOR Cards, descriptions of the various grades, and explains the individual Data Stock Lists available for every grade. For your own copy ask your Allegheny Ludlum sales representative, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. TE-1.***

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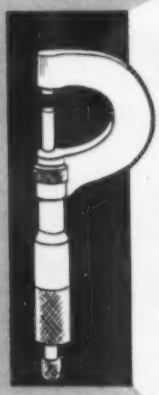

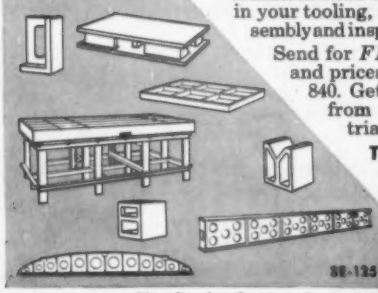

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SB-125

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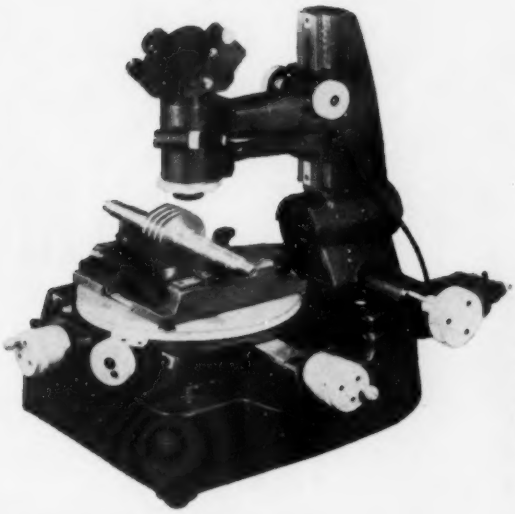

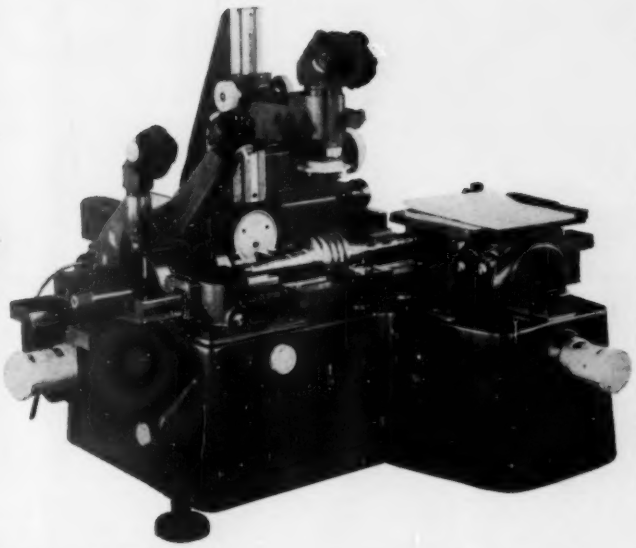

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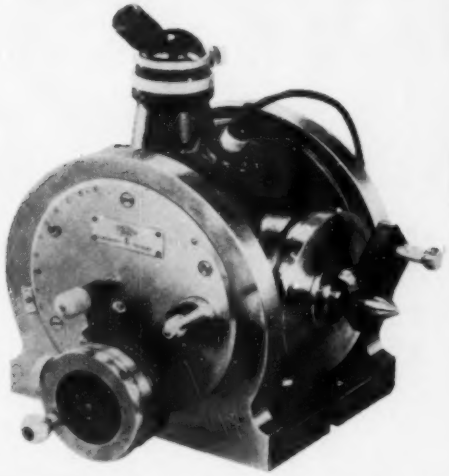
This versatile inspection and production measuring instrument is extremely rugged, accurate and simple to operate. Flexibility is enhanced through use of numerous accessories. Areas of application include measurement of length, angles, screw threads and contours.

Technical Data: Measuring range 6 x 2 in. • Micrometers read to 0.0001 in. • Angular scale of goniometer ocular 1 min. • Diameter of circular stage 11 in. • Magnifications 10x to 50x



OPTICAL DIVIDING HEAD — MODEL 130

This sturdily-constructed, precision instrument measures angles in the order of 10 sec. of arc (5 sec. by estimation) utilizing a newly developed scale which permits extreme accuracy and repeatability of readings. The model 130 may be used as an inspection instrument or on surface grinders, millers and drill presses without any loss of accuracy. The wide range of applications include cam shaft inspection when the instrument is used together with the Abbe measuring unit.

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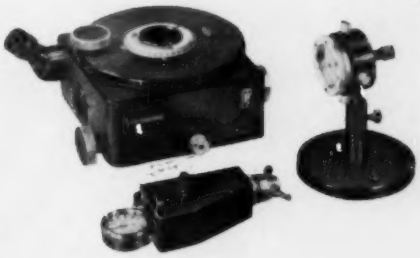
The perfect laboratory and production instrument for a variety of precise measuring techniques including a wide range of applications from simple linear measurement (internal and external) to intricate coordinate measurement. Accessories permit lead screw and cam shaft inspection as well as concentricity and taper measurement.

Technical Data: Measuring range 8 x 4 in. • Precision glass scales read to 0.00005 in. • Can be read by estimation to 0.00001 in. • Scale of accessory rotary table to 30 sec. • Angular scale of goniometer ocular 1 min. • Magnifications 10x to 50x



ANGLE DIVISION TESTER — ONE SEC.

The newly designed Zeiss Angle Division Tester is used to check and measure angles with a high degree of precision. Among its many applications are checking dividing heads, rotary tables, gears, polygons, etc. It may also be used in setting angles for the manufacture of index plates, gears, slotted discs and circular scales.

Technical Data: Fine scale reads to 1 sec. • Glass graduated scale reads to 10 min. • Coarse graduated scale reads to 1 deg.

Complete information may be obtained from your local Carl Zeiss Jena instrument dealer or by writing: Dept. TME 1/61

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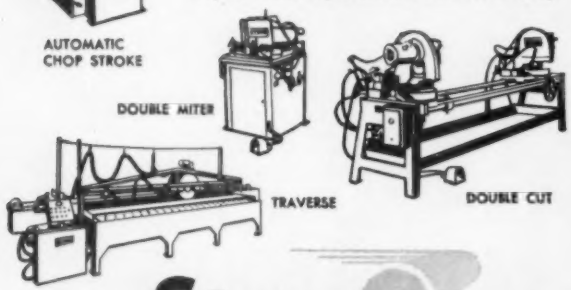

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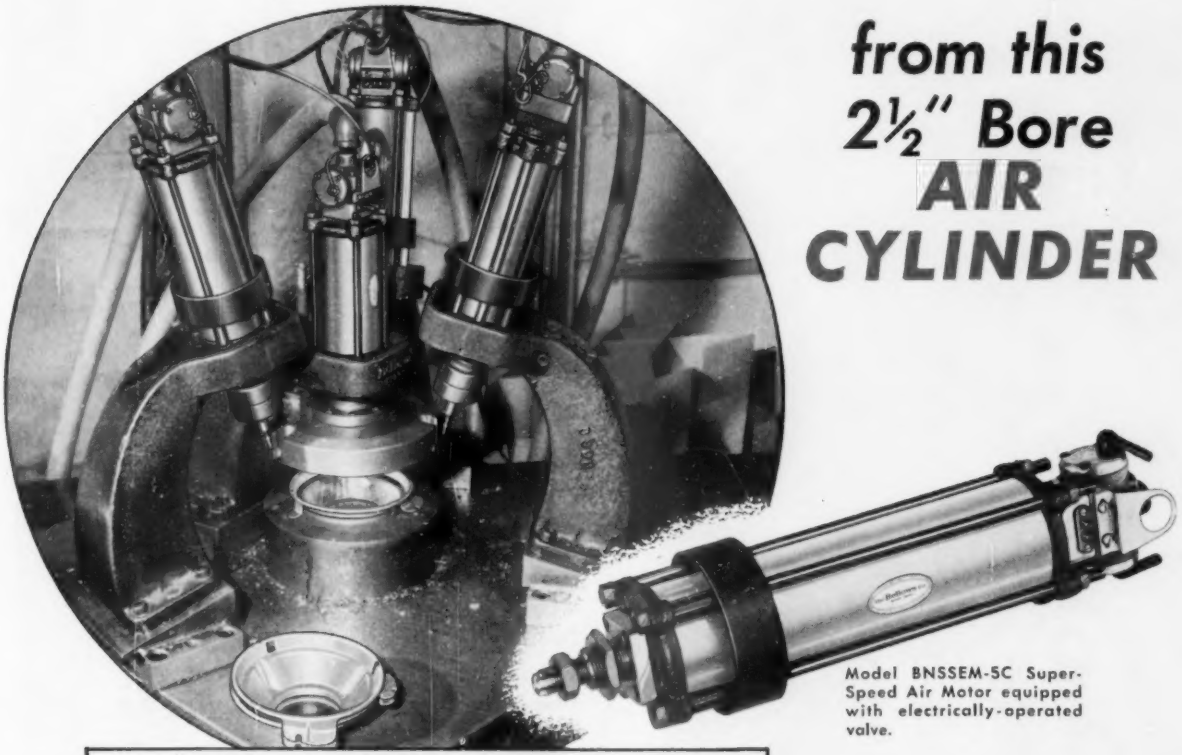

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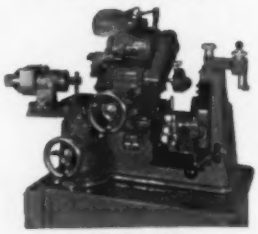

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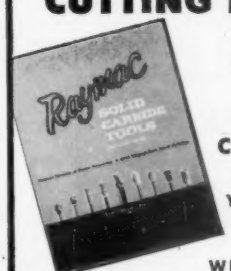

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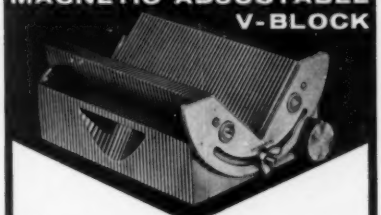

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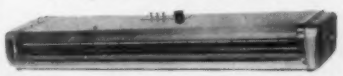

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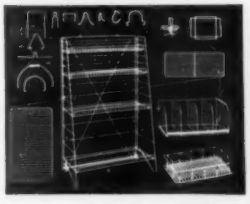

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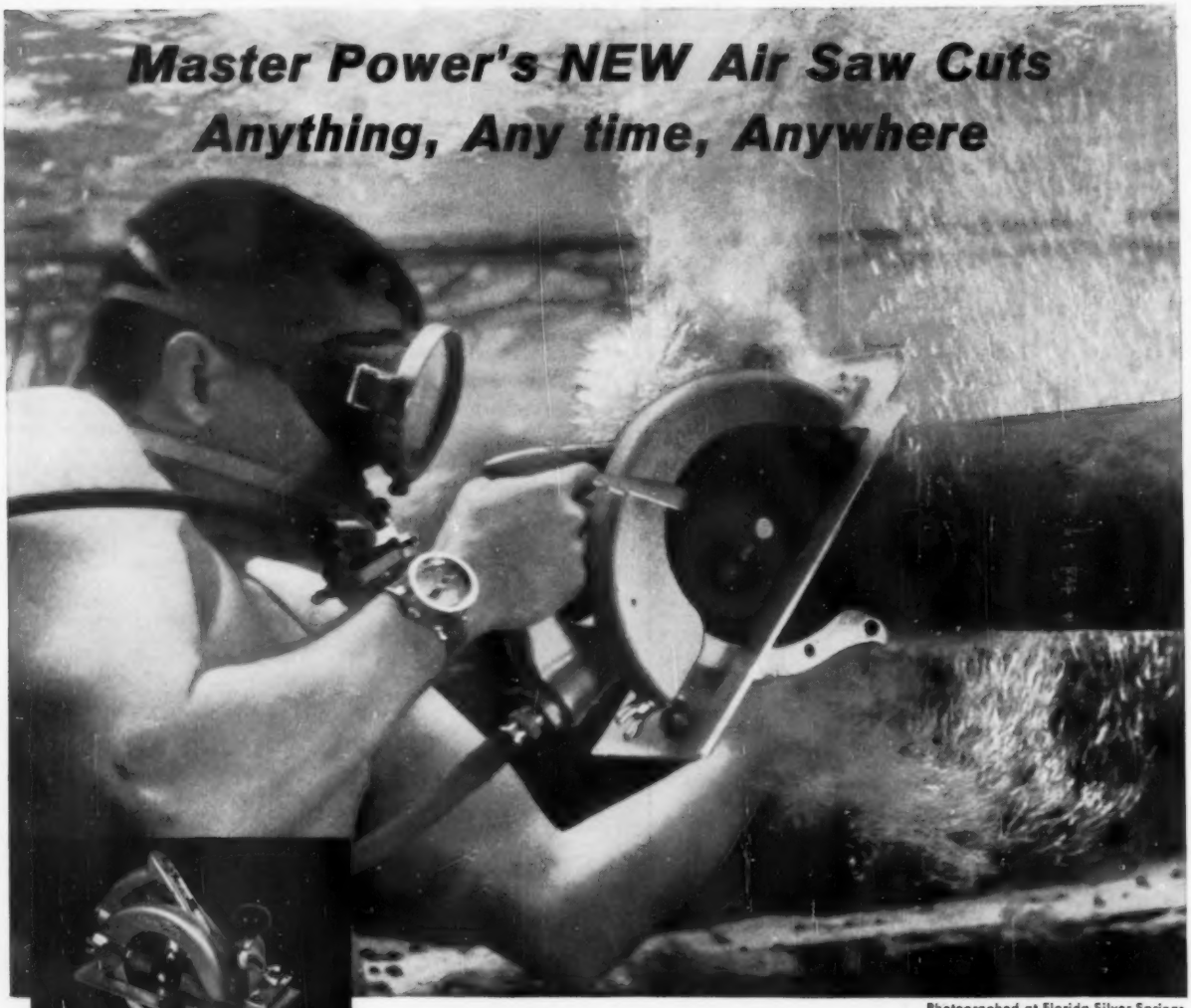

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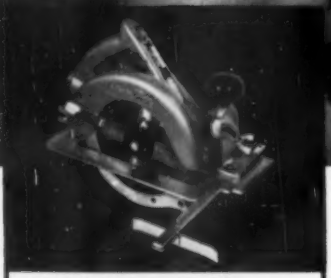

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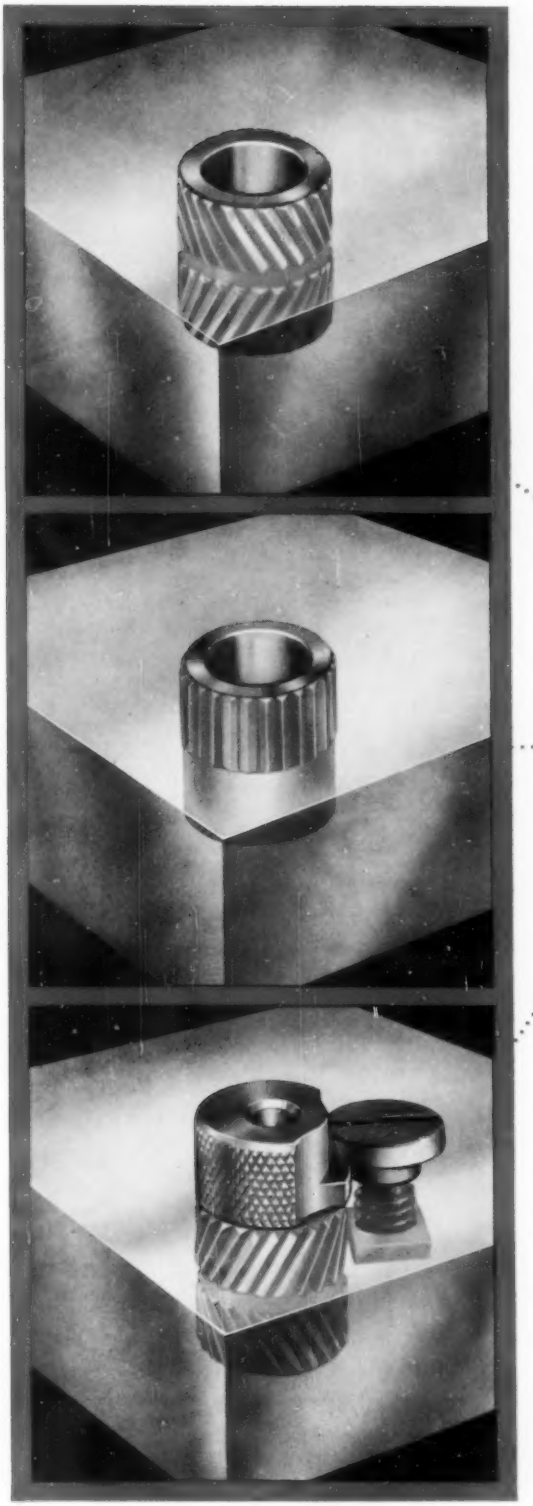

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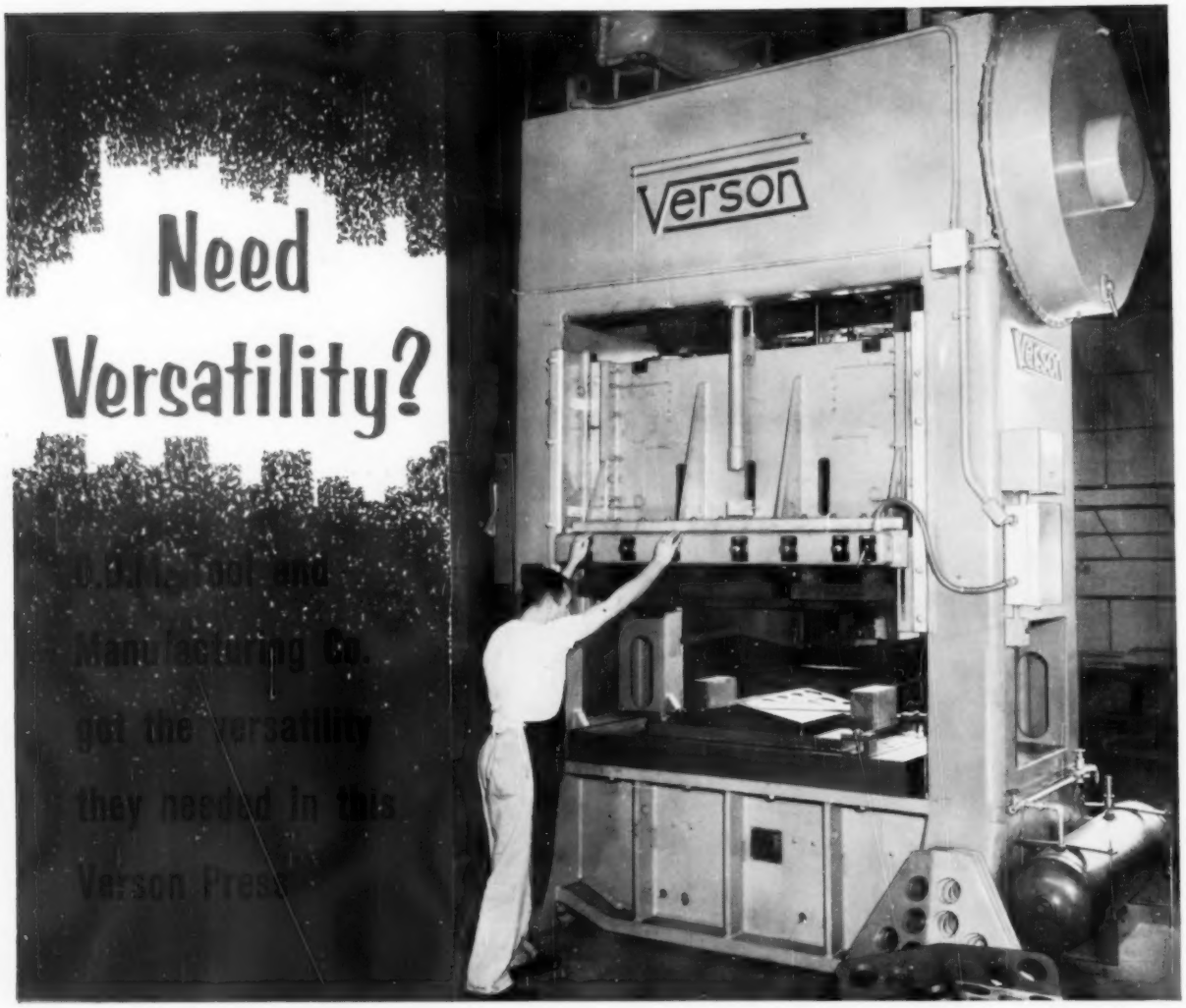

When the O.D.M. Tool and Manufacturing Company, McCook, Illinois, went shopping for a press, they knew what they wanted. Being a contract stamping tool and die shop, they needed a rugged, yet versatile press that could be operated economically on short run jobs . . . they bought a Verson.

Shown above, the Verson 150 ton double crank press is performing a restrike operation on 10 gauge tank turret parts, previously formed in the same press. Slide and bolster area is 42″ x 72″; floor space, 98″ x 143″; weight, 52,000; power adjustment of the slide, 8″; stroke, 14″. Additionally, the press is equipped with two Verson "U" type pneumatic die cushions, separately adjustable.

If your shop must handle a wide variety of jobs as part of daily routine, a press from Verson's extensive line may be your most effective profit builder. Verson Application Engineers will be pleased to go over your requirements and help you select the press best suited to your needs. Call or write today.

Originators and pioneers of allsteel stamping press construction

VERSON ALLSTEEL PRESS CO.

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